Programs for the Mathematical Education of Prospective Elementary School Teachers in Southeastern States

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CHAPTER I

INTRODUCTION

The elementary school is considered by many to be the most important division of the entire educational system. It is here that the greatest number of boys and girls are educated for the longest period of time. At this level the foundation is laid for a realization of the habits, skills, knowledges, ideals, attitudes, and appreciations which are believed to be desirable for all citizens in a free and democratic form of government.

Through the years the people through legislation have made it the responsibility of the state to provide educational opportunity for their children. However, legislators have not been prone to prescribe the manner in which the children were to be taught nor to make exhaustive inspections of teaching procedures. Instead, all of the states have attempted to get desirable teachers by the enactment of certification laws and the establishment of state institutions for the education of teachers.

Need for the Study

In order that teacher education may be the very best that the separate institutions may provide for the prospective teachers, it is desirable that there be continuous research, experimentation, and study to aid in the development and evaluation of their programs.

Many college teachers have been accused of being reluctant to accept ideas that would necessitate changes in the established routine

of their class procedures. The reluctance to carry on continuous research, experimentation, and study has perpetuated obsolete methods and materials which have been costly and detrimental to the elementary education program.

The arithmetic content in the textbooks and the grade placement of topics have changed little in the past ten years. However, there is evidence supported by reports from conferences of curriculum groups to show that elementary teachers are not in agreement on philosophy, aims, modes of learning, and practices in the teaching of arithmetic.[1]

This lack of agreement was recently emphasized by Suelts who is editor of a section on arithmetic in The Mathematics Teacher:

> The divergence of elementary school programs is at present time greater than it has been at any other time during the past century. This divergence applies to all phases of arithmetic: to mode of learning, to content, to seriousness of purpose on the part of both the school and the pupil, and to the point of view toward the role of arithmetic in the life of the individual. Perhaps the greatest unifying influence at the moment is the similarity of content of the textbooks.[2]

Suelts[3] in an earlier article pointed out that a tentative agreement upon basic ideas would not only save time but would also point the way toward the formulation of major policies.

There is a growing discontent with the achievement in mathematics at both the elementary and secondary school levels. Attention has been

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[1] Ben A. Suelts, "Important Issues in Arithmetic," The Mathematics Teacher, XLII (April, 1949), 197-199.

[2] Ben A. Suelts, "Arithmetic," The Mathematics Teacher, XLII (November, 1949), 359.

[3] "Important Issues in Arithmetic," loc. cit.

called to numerous examples of pupils not being able to meet the standards imposed upon them by the junior high school, business men, and the armed forces. Sueltz and Benedick writing in The Mathematics Teacher hold the point of view that:

> . . . people in business and industry, as well as representatives of the armed services in the late war, have repeatedly asked that curriculum workers and mathematics teachers do something (almost anything) that will educate the common citizen so that he has at least a modicum of competence in the mathematical situations with which he is repeatedly confronted.[4]

The following weaknesses in arithmetic were reported from the results of tests given to more than 2000 pupils in three states in the eastern area of the United States:

> In computation: (1) basic number combinations in all processes, (2) all computations with whole numbers when exercises were not simple or very short; (3) judgment of associating a process with a situation; (4) errors in computation, in copying figures, from messy work, and in short cuts arising from being smart

> In understanding: (1) basic concepts of whole numbers, fractions, and measures: (2) principles and relationships of fractions, and of measures; (3) the essential mathematical process inherent in common situations; (4) number relationships within a process and the relationship of one process to another

> In judgments: (1) size of common units of measure and of familiar objects to be measured; (2) fractional relationships with real things and with pictorial figures; (3) common economical and social information and principles; (4) why and when to use one process rather than another for

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[4] Ben A. Sueltz and John W. Benedick, "The Need for Extending Arithmetical Learnings," The Mathematics Teacher, XLIII (February, 1950), 69.

economy of time and energy; (5) orderly arrangement and sequence.[5]

It is interesting to note the close agreement between the above skills and concepts and the following list of fundamental concepts which the Commission on Post-War Plans listed as the ones which are taught in the first six grades:

1. Basic concepts, processes, and vocabulary of arithmetic
2. Our decimal system of numeration, including the concept of decimal fractions
3. Computation, whole numbers and common and decimal fractions
4. Principal units of measurement for everyday use
5. Solution of problems involving computation and units of measurement
6. Identification of geometric figures
7. Use of simple graphs
8. Estimation and checking of answers to problems.[6]

The question arises as to why so much criticism should be directed toward one subject in the elementary field. Glennon[7] attempted to answer the question in his study by measuring the extent of growth and mastery of certain basic mathematical understandings possessed by three groups of prospective elementary school teachers: teachers college freshmen, teachers college seniors, and teachers-in-service. Glennon's test covered five areas of basic mathematical understandings: (1) the decimal system of notation, (2) basic understandings of integers and processes

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[5] Ibid., p. 70.

[6] "Guidance Pamphlet in Mathematics for High School Students," Final Report of the Commission on Post-War Plans of the National Council of Teachers of Mathematics (New York: The Mathematics Teacher, 1947), pp. 10-11.

[7] Vincent J. Glennon, "A Study in the Needed Redirection in the Preparation of Teachers of Arithmetic," The Mathematics Teacher, XLII (December, 1949), 389-396.

(3) basic understandings of decimals and processes, (4) basic understandings of fractions and processes, and (5) basic understandings of the rationals of computation. These fundamental concepts were listed by the Commission on Post-War Plans as concepts which were taught in the first six grades and also as the difficulties which were reported by the study conducted in the Eastern area.

Glennon reported the following average per cent of achievement of basic mathematical understandings for each level:

> 1. The Teachers College Freshman understands about 44% of the basic mathematical understandings tested. These understandings are basic to the computational processes taught in grades one through six!
> 2. The Teachers College senior understands about 43% of these basic mathematical understandings!
> 3. The Teacher-in-service understands about 55% (slightly more than half) of the understandings that are basic to the computational processes commonly taught in grades one through six!!![8]

The findings reported in Glennon's study do not present a very optimistic picture of the achievement of basic mathematical understandings on the part of student teachers and teachers -in-service. Glennon in the following remarks emphasizes the need for additional research studies.

> Since both carefully controlled research studies and other less-precise methods of rational inquiry have proven the worth-whileness of teaching for understanding, we must accept the responsibility for doing so. We are now in a position to create an "all out" effort to discover new methods and materials for teaching and evaluating for growth in basic mathematical understandings.[9]

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[8] Ibid., p. 393.

[9] Ibid., p. 396.

It would seem, therefore, that a need for a study of the education of elementary arithmetic teachers could be summarized in the following statements:

1. Teacher education to be effective must involve a continuous process of research and evaluation. This research and evaluation has not been continuous in the field of arithmetic education of elementary teachers; and this lack of research has tended to perpetuate obsolete methods.

2. Elementary teachers are not in agreement on philosophy, aims, modes of learning, and practices in the teaching of arithmetic.

3. The elementary schools have been criticized persistently for the deficiencies in arithmetic which their products exhibit.

4. Many college seniors among prospective teachers as well as large numbers of in-service teachers have not exhibited a clear understanding of the computational processes commonly taught in grades one through six.

5. In order to understand, clarify, and make recommendations for improvement in the education of elementary arithmetic teachers, it is desirable that a detailed study be made of the educational programs provided for prospective elementary arithmetic teachers.

Purpose of Study

It is the purpose of this study to analyze the programs for the mathematical preparation of elementary teachers in a selected group of teacher education institutions in the Southeastern states and to make

recommendations for the improvement of these programs.

Specifically, it is the intent of the study to answer the following questions:

1. What mathematics content and methods in the teaching of arithmetic do the selected states require for certification to teach in the elementary schools?

2. How many hours of mathematics content and methods in the teaching of arithmetic are required by the teacher institutions?

3. What mathematical concepts and processes are taught in the content courses to prospective elementary teachers?

4. What experiences are offered in the "so-called" methods courses dealing with arithmetic?

5. What provisions do the teacher education institutions make for in-service arithmetic education of elementary teachers?

6. What mathematical programs are offered by the junior colleges that have two-year teacher education programs?

7. What specific recommendations can be made for improvement of arithmetic education of prospective elementary teachers in the Southeast?

Assumptions and Limitations

The term arithmetic is defined as a study of the significance and uses of numbers in the social, cultural, economic, and industrial situations most commonly found in everyday life. Number concepts and computations are necessary in practically every subject and at every level. It would be a prohibitive task to analyze all of these skills and

concepts and their uses; therefore, this study was limited to an analysis of the courses in mathematics and methods of teaching arithmetic which are required or offered for teacher education for the elementary schools. The term, mathematical preparation, was specifically used in this study to designate education in mathematics content and methods of teaching arithmetic. The term, elementary school, was used to designate grades one through six. Throughout the study the terms mathematics and arithmetic are used interchangeably.

This study is an analysis of the established courses provided in the teacher education programs. No effort was made to analyze the elective courses which individual students may have completed in mathematics.

The time and resources for conducting this study were limited; consequently, the institutions to be studied were limited in number. The study was confined to the nine Southeastern states, namely, Alabama, Florida, Georgia, Mississippi, Kentucky, Tennessee, North Carolina, South Carolina, and Virginia. Because these states differ from other regions of the United States, and because the selection[10] of schools within these states was not made in a strictly random manner, findings should not be considered as representative of the entire United States.

In nineteen of the fifty four-year institutions the mathematical education of the prospective elementary teachers was entirely under the supervision of the education departments. The members of the mathematics departments in these nineteen institutions were not interviewed.

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[10] Criteria for selection are given on page 36.

It was pointed out by two of the directors of elementary education that their intern teaching programs were a very important part of their content education in all fields usually taught in the elementary schools. In these two institutions the intern teachers were under the supervision of college staffs and the directing public school teachers and supervisors. The intern teaching was conducted off-campus. Time and facilities did not permit the inclusion of the additional contacts necessary to cover this phase of the prospective elementary teachers' education.

CHAPTER II

BACKGROUND FOR THE STUDY

There is a recognized paucity of research studies which have been conducted in the field of teacher education. An examination of articles in Educational Index reveals a relatively large number of articles proposing new programs, new courses, general aspects of the curriculum and objectives and only a few articles giving an extensive evaluation of various programs, courses, teaching competencies, and causes for teacher failures. An analysis of research carried on with respect to teacher rating impresses the reader with the difficulties inherent in securing valid measures of teaching effectiveness.

Review of Related Research

The related research was divided into two categories: namely, studies of the certification requirements of elementary school teachers in the United States and surveys of the programs provided by the teacher education institutions for prospective elementary arithmetic teachers.

In 1945 Blyler[1] made an exhaustive study of the certification requirements of elementary school teachers in the United States. Sixteen of the forty-eight states required a definite pattern of courses. The subjects were grouped under seven headings: social studies, physical education-health-safety, mathematics, science, language arts, fine arts, and practical arts.

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[1]Dorothy Blyler, "Certification of Elementary Teachers in United States," Elementary School Journal, XLV (June, 1945), 578-589.

Blyler found that the minimum number of semester hours of mathematics required in these sixteen states was two, the maximum was five, and the average three and four-tenths semester hours.

Layton in 1947 made an analysis of certification requirements for teachers of mathematics. His analysis of the situation in the elementary school reveals that:

> The requirements in content mathematics for the lowest and highest initial elementary certificates are lower by far than the requirements in English, geography, and art. Some nation-wide means for the lowest certificate, expressed in semester hours, are: mathematics content .52; methods in mathematics .16; English content 3.92; geography content .87; art content 1.13. . . .
>
> Very few of the states require any training in either mathematics content or methods, only ten specifying any training in mathematics content for the lowest initial elementary certificate and no state requiring more than five semester hours in mathematics content for this certificate. For the highest initial elementary certificate only eleven states call for training in mathematics content with five hours again being the greatest number required. Only five states stipulate training in methods in mathematics.
>
> Many more states are concerned with professional courses in the training of elementary teachers than with mathematics content courses.[2]

Layton made the following recommendations for certification of elementary teachers:

> A bachelor's degree
>
> A minimum of six semester hours in content mathematics consisting of a college course in arithmetic and one in general mathematics
>
> The college course in arithmetic should be such as to insure a competence over the whole range of subject matter which is usually included in elementary arithmetic. The course in general mathematics should be non-technical in

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[2] W. I. Layton, "The Certification of Teachers of Mathematics," The Mathematics Teacher, XLIII (December, 1949), 378.

nature dealing with topics in algebra, geometry, trigonometry, business problems, and statistics. As an alternate to these courses the candidate for the elementary certificate should be permitted to submit six semester hours in college algebra and trigonometry.

Professional courses including practice teaching, educational psychology, observation in teaching, principles of education, general psychology, general methods of teaching, and the curriculum[3],

In 1932 Judd and Morton sent questionnaires to 142 institutions which were members of the American Association of Teachers Colleges. The object was to determine the current practices in teacher education in arithmetic. Their findings included the following results:

1. Thirty-five different publications are used as textbooks, counting a series of elementary school arithmetic textbooks as one publication. . . . (Morton, Roantree-Taylor, Taylor, and Stone-Mallory-Grossnickle were the most frequently used texts.)
2. As reported by 96 institutions, the per cent of time devoted to methods in teacher-training courses in arithmetic ranges from 0 to 100. . . .
3. Of 101 institutions answering a question pertaining to prerequisites, 30 indicated that they have prerequisites for this course and 71 that they have none.
4. Of 104 institutions answering a question as to whether there was a training requirement in arithmetic for teacher certification, 84 indicated that there was such a requirement and 20 that there was not.
5. Of 96 institutions reporting on the subject of general and differentiated courses in arithmetic, 55 indicated that they offer courses on the primary and intermediate levels separately, while 41 offer only the general type of course.
6. The number of semester hours' credit carried by training courses in arithmetic ranges from 1 to 4. Sixty per cent of the 151 courses reported by 96 institutions carry three semester hours of credit.
7. In 52 of 103 institutions reporting, arithmetic courses are accepted as mathematics toward a degree, while in 51 institutions arithmetic is not classified as mathematics for this purpose. . . .

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[3] Ibid., p. 379.

> 8. Classes in courses in the teaching of arithmetic range in size from less than 10 to more than 70. The median for these classes is 33.8.
>
> 9. Of 102 institutions reporting as to whether demonstration lessons were taught in the training school for the classes in arithmetic, 57 indicated that such lessons were provided while 45 indicated that they were not. The number of demonstrations ranges from 1 to 12 with a median of 5.8 . . . .
>
> 10. Among the devices rated, tests, graphs, and flash cards were considered to be of relative large worth; games, notebooks, crutches, and number pictures were given an intermediate rating; and rhymes and puzzle problems were thought to be of relative little value.
>
> 11. Marked variability is shown in the proportion of class time which is taken up by various methods of instruction . . . .
>
> 12. Judgments of suggested time allotments for a three-semester-hour course showed much difference of opinion. There was a definite disposition to devote less than six of the fifty-four class hours to the history of arithmetic and less than 6 hours to the objectives of arithmetic. . . .[4]

The study supplied considerable information relative to prevailing practices in the education of teachers of arithmetic but did not indicate which of the practices were desirable and which were undesirable.

The United States Office of Education appointed a committee in 1933 to make a National Survey of Education of teachers.[5] They found the following size of prescriptions in mathematics, according to a catalog analysis of sixty-six teachers colleges and normal schools:

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[4] Romie Dustin Judd and Robert Lee Morton, "Current Practices in Teacher-Training Courses in Arithmetic," The Teaching of Arithmetic, Tenth Yearbook, National Council of Teachers of Mathematics (New York: Bureau of Publication, Teachers College, Columbia University, 1935), pp. 157-172.

[5] U. S. Office of Education, National Survey of the Education of Teachers, Bulletin No. 10 (Washington, D. C.: U. S. Government Printing Office, 1937), p. 517.

	Per cent Prescribing Mathematics	Range of Credits	Median of Credit
Four-year Curricula			
Elementary	52	2-10	8
Intermediate	72	1-13	6
Kindergarten	52	2-9	6
Rural	82	1-8	6
Upper grades	65	3-10	5
Three-year Curricula			
Elementary	88	2-10	6
Intermediate	100	2-5	4
Kindergarten-Primary	92	2-10	4
Rural	80	3-6	4
Upper grades	67	4-6	5
Two-year Curricula			
Elementary	64	2-5	4
Intermediate	80	1-6	3
Kindergarten-Primary	62	2-4	3
Rural	68	1-5	3
Upper grades	67	2-8	3
One-year Curricula			
Rural	60	2-5	3

In 1933 Robinson conducted a survey to determine the education of elementary teachers in the field of arithmetic. The picture of the preparation of these teachers was obtained from an analysis of the catalogs of 141 normal schools and teachers colleges and from reports of the teachers of arithmetic courses in twenty-four normal schools and teachers colleges. The needs of elementary teachers of arithmetic were determined from four sources:

1. An analysis of the questions and answers of approximately 19,000 candidates for license to teach in the elementary schools of New York City. These examinations covered knowledge of arithmetic and ability

to use arithmetical processes and applications to psychological and educational principles dealing with the teaching of arithmetic

2. Detailed account of 652 observations of the teaching of arithmetic in twenty-eight New York City Schools

3. Special arithmetic examination papers of 322 teachers employed in New York City and suburban communities

4. Studies reporting the teaching difficulties of arithmetic in elementary schools

A few of the more significant findings from Robinson's report are:

> Elementary teachers as a whole are fairly proficient in the manipulation of the mechanical processes of arithmetic but are significantly lacking in their knowledge of the fundamental processes
>
> Teachers in this group failed to use many of the fundamental and accepted principles of effective teaching in their teaching of arithmetic
>
> The thirty-seven teachers who were teaching the professional courses in the normal schools had almost in all cases a master's degree and nearly twelve years of teaching experience
>
> The median number of clock hours in the selected institutions of professional courses in arithmetic is in the neighborhood of 36-40 clock hours with the teachers of the courses suggesting 50 per cent more time needed
>
> The phases which received the most time in the activities of the professional courses were: rational topics, applications of psychology to teaching, methods of teaching, and review of the elementary subject matter.[6]

Taylor, of Eastern Illinois State Teachers College, read a paper at the annual meeting of the National Council of Teachers of Mathematics

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[6] Arthur E. Robinson, The Professional Education of Elementary Teachers in the Field of Arithmetic, Teachers College Contribution to Education No. 672, Teachers College, Columbia University, 1936. Reported in U. S. Office of Education Bulletin No. 10, (Washington, D.C.: U. S. Government Printing Office, 1935), pp. 474-477.

at Atlantic City in 1938 in which he reported:

> In 1928 I examined the published curriculums of 187 normal schools and teachers colleges in 42 states to determine the extent and character of the offerings in arithmetic in those institutions. The study was repeated in 1935 for 128 such institutions in 39 states. The results show that there was a noticeable decrease from 1928 to 1935 in the number of semester hours of arithmetic offered, and also in the number of semester hours required in curriculums for the preparation of elementary school teachers. In 1935 no arithmetic whatever was offered in 12.5% of the teacher training institutions whose curriculums were examined, and none was required in at least 25% of the curriculums for the preparation of elementary school teachers. More than 50% of all the semester hours of arithmetic offered were given in courses devoted mainly or wholly to methods, and 11.6% of all semester hours offered were given by departments of education.
>
> From the above studies it seems probable that at least 50% of beginning elementary teachers do not study arithmetic in college, and begin teaching a subject the science and psychology of which they are essentially ignorant. How do I know they remain ignorant? I have found it out in attempting to teach arithmetic to hundreds of teachers with from one to thirty years of experience.
>
> What should the teachers college do about it? A four-year course for the preparation of teachers for the elementary schools should contain not less than eight semester hours of mathematics. Students who have not had two years of high school mathematics should be required to take an extra course. The required courses should deal in the main with arithmetic, but should not be called arithmetic both to avoid a bad label for those students who think that a course in arithmetic is below their level, and because these should not be a course in arithmetic in the elementary school sense. The aim of these courses is to prepare teachers of mathematics.[7]

The two studies concerned with certification requirements of the elementary school teachers in the United States revealed that few states

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[7] E. H. Taylor, "Mathematics for a Four-Year Course for Teachers in the Elementary School," School Science and Mathematics, XXXVIII (May, 1938), 500-501.

required any education in either mathematics content or methods. Most of the studies dealing with mathematics requirements which were based upon analyses of the catalogs of teacher education institutions revealed that the individual institution requirements were higher than their state certification requirements. However, the majority of the studies included in their recommendations the need for additional mathematical education for prospective elementary teachers.

Opinions of Individual Writers on Arithmetic Education of Elementary School Teachers

One of the earliest recorded expressions of the need for better prepared teachers was made by Benjamin Franklin. He expressed this need in a proposal made in advocating the establishment of the Academy and Charitable School of the Providence of Pennsylvania, chartered in 1753.

> . . . A number of the poorer sort will hereby be qualified to act as schoolmasters in the country, to teach children reading, writing, arithmetic, and the grammar of their mother tongue, and being of good morals and of good character, may be recommended from the academy to country schools for that purpose — the country suffering very much at present for want of good schoolmasters.[8]

Conditions had improved very little by the end of the first quarter of the nineteenth century. Samuel R. Hall in his lectures on School Keeping, published in 1829, explains that many of the deplorable condi-

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[8] James P. Wickersham, A History of Education in Pennsylvania, (Philadelphia, Pa.: Inquirer Publishing Co., 1886), p. 60.

tions then existing in the schools were due to the failure to secure educated teachers.

> Every stripling who has passed four years within the walls of a college, every dissatisfied clerk who has not ability enough to manage the trifling concerns of a retail shop, every young farmer who obtains in the winter a short vacation from the toils of summer — in short, every person who is conscious of his imbecility in other business, esteems himself fully competent to train the ignorance and weakness of infancy, into all the virtue and power and wisdom of maturer years — to form a creature, the frailest and feeblest that heaven has made, into the intelligent and fearless sovereign and adorer and almost the representative of Divinity.[9]

John S. French, Professor of Mathematics, Jacob Tome Institute, Port Deposit, Maryland, reported in the National Education Association Addresses and Proceedings in 1904 on what he considered the difficulties and problems in the teaching of elementary arithmetic. A summary of that report shows that many of those difficulties and problems still exist.

> The inefficiency of the teachers of mathematics is one of the serious problems for solution in our educational work. It seems to come from a tendency to rely too much on the textbook, which in turn is due primarily to a narrow knowledge of the subject, on the one hand, and a lack of appreciation of the student's powers of comprehension, on the other. In the grades the pupil should obtain a working knowledge of the fundamental operations of arithmetic, tested by his skill in using the tables and in applying them to continued multiplication and division; with an appreciation of algebraic notation as used for abridging and facilitating arithmetical processes; and with a true concept of geometric figures and a knowledge of certain mutual relations between them. All instruction in arithmetic should be centered about the fundamental operations,

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[9]U. S. Department of the Interior, Office of Education, National Survey of the Education of Teachers, VI (Washington, D. C.: Government Printing Office, 1933), 29.

> and the topics of factoring, fractions, percentage, interest, taxes, and simple denominate numbers should tend to give practical applications of these operations. The introduction of algebraic process should be gradual and brought about in such a way as to make the pupil appreciative of the generalities of algebra. The introductory work should include the fundamental operations, factoring, highest common factor, least common multiple of monomials, fractions, the solution of all arithmetical problems by the equation as long as consistent with facility, and very elementary work with type-form. The study of geometry should bring into use the metrical properties as usually taken up in mensuration.[10]

Bailey, in an address before the National Education Association in 1905, made it seem quite simple to obtain the objectives as stated by French:

> The principal factors in the teaching of arithmetic are the course of study, the textbook, and the teacher. The office of the course of study is to indicate the order in which the topics shall be considered, and to assign the time within which each shall be completed; the office of the textbook is to indicate the order of the topics, and to present them in such a manner that the learner may master them without assistance; the office of the teacher is to give the same instruction by word of mouth which is given in the textbook by the printed page, and to direct the learner. . . . Great care should be taken in the selection of the textbook in the first place; but after the book has once been selected, the teacher should be required to follow its presentation.[11]

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[10] John S. French, What Study of Mathematics Is Needed by the Man of Average Education for Practical Life? A report to the Forty-Third Annual Report of Addresses and Proceedings of the National Education Association, St. Louis, June 27 to July 1, 1904. Prepared by National Education Association (Washington, D. C., 1904), pp. 510-514.

[11] M. A. Bailey, Teaching of Arithmetic in the Elementary Schools. A Report to the Forty-Fourth Annual Report of Addresses and Proceedings of the National Education Association, Asbury Park and Ocean Grove, New Jersey, July 3 to July 7, 1905. Prepared by the National Education Association (Washington, D. C., 1905), pp. 380-381.

In all probability, very few arithmetic teachers have ever read the above quotation; however, arithmetic teachers in general have been indicted by writers for following the mechanistic approach. The fact that this approach does not get the desired results is evidenced by the criticism that has been directed toward the teachers. Bailey's mechanistic idea was not the only method of presentation advocated by the writers of fifty years ago. Boyden[12] in writing on the "Essentials of Arithmetic" listed good teaching as the first important essential. Boyden's theory was more in agreement with the philosophy which is described today by the words "meaning" and "understanding." He warned against teaching arithmetic in a mechanical way which would lead to much ciphering and little thinking. In contrast to Bailey's idea of adhering to the textbook, Boyden advocated a complete logical arrangement of arithmetic by better illustrations of the ideas and processes and more problems which occur in actual life.

Practically everybody who has written or spoken on the education of elementary arithmetic teachers has bemoaned their qualifications. This statement is well borne out by an examination of the articles in the current journals. Many of the contributors of these journals express a lack of confidence in the mathematical ability of the elementary

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12 Albert G. Boyden, "The Essentials of Arithmetic," Education, XIV (March, 1894), 390-398.

arithmetic teacher. Hoel,[13] Reeve,[14] Carter,[15] Grime,[16] Potter,[17] and Brueckner[18] are representative of these contributors.

Lesta Hoel, Supervisor of Mathematics, Portland, Oregon, made a study of group difficulties in arithmetic and listed the factors which cause the difficulties, all of which are the earmarks of poor teaching. The factors were:

> 1. The teacher may have insisted that there is a correct way to do a certain type of problem which may not be the easiest way for the child and the one which he will understand.
> 2. The instruction may have been aimed at the average (or even the above average) and pupils with difficulty get discouraged, and begin to have troubles.
> 3. As mentioned above, the abstract process may have been presented too early; or it may have been taught from a textbook instead of from real life situations. . . .
> 4. Too much emphasis may have been placed upon speed, upon getting the answer, neglecting the emphasis upon content and meaning.

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[13] Lesta Hoel, "What Constitutes Remedial Work in Arithmetic?" The Mathematics Teacher, XLIII (January, 1950), 22.

[14] W. D. Reeve, "Modern Trends in Mathematics Education," School Science and Mathematics, XLVIII (January, 1948), 21.

[15] Paul D. Carter, "From a Mechanistic to a Meaningful Program of Arithmetic; A Suggested Approach," School Science and Mathematics, XLVII (October, 1947), 606.

[16] Hershel E. Grime, "A Plan for the In-Service Training of Teachers in the Elementary School," School Science and Mathematics, XLVIII (October, 1948), 517.

[17] Mary A. Potter, "Maintenance and Remedial Opportunities for the Average and above Average Student," The North Central Association Quarterly, XXI (April, 1947), 455-458.

[18] Leo J. Brueckner, "Improving Mathematical Abilities of Pre-Induction Groups," Bulletin of the National Association of Secondary School Principals, XXVII (December, 1943), 33-48.

5. The teacher may have failed to recognize that children learn through seeing, hearing, touching, speaking, handling. No avenue should be omitted.

6. Certain basic concepts may be lacking; they may have been taught by rule (perhaps by the parents). . . .

7. The group may not be ready for the new processes when presented. Diagnose before introducing any new subject in order to determine the strength of each student. On the basis of this diagnosis, clear up any difficulties before introducing the new material.[19]

This list of factors of poor teaching which was published in 1950 is in close agreement with Kellner's[20] "Six rules for teaching arithmetic badly" which were published in his Volksschulkunde at Essen in 1868.

As a result of their experience in working with teachers, Carter of the Birmingham Public Schools and Grime of the Cleveland Public Schools expressed dissatisfaction with the elementary teachers of arithmetic. In their articles they stress the points that the majority of elementary arithmetic teachers are deficient in the handling of the fundamental skills and concepts of arithmetic; and, that they are in great need of help in interpreting the philosophy and in putting this philosophy into practice.

Mathematics teachers at all levels have been shaken from their complacency by the criticism which has been directed toward their work. The unfavorable denouncements of elementary arithmetic teachers which have been included in this study are only a sample of the opinions

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[19] Hoel, op. cit., pp. 22-23.

[20] T. H. Safford, "Modern Teaching of Arithmetic," Atlantic Monthly, LXVII (May, 1891), 674-675.

that have been written; however, these opinions seem sufficiently inclusive to show that there is disagreement with the effectiveness of instruction in elementary arithmetic.

Reports of Agencies on the Teaching of Arithmetic

Throughout the years several groups of leaders interested in the education of teachers have served on panels or commissions that have conducted studies and presented recommendations for programs dealing with the education of prospective arithmetic teachers.

One of the early commissions was the International Commission on the Teaching of Elementary Mathematics which was sponsored by the United States Bureau of Education in 1911. Committees I and II presented the following recommendations for a course for the education of elementary teachers of arithmetic:

> 1. A foundation in subject matter as a basis for the professional study of mathematics should include a minimum of one-half year of high school arithmetic, one year of algebra, and one year of geometry.
> 2. Exclusive of all courses in psychology, pedagogy, principles of teaching, general methods, and history of education, a minimum of one-half year of the professional study of arithmetic should be required to include the following:
>
> A. The teaching of elementary mathematics
> a. The teaching of pedagogy of arithmetic
> 1. The more elementary phases of the psychology of number
> 2. Principles of general method applied to teaching arithmetic
> 3. Educational value of arithmetic and the place of arithmetic in the general education scheme
> b. The organization of the general elementary school curriculum in arithmetic
> c. Organization of typical units of subject matter for presentation to appropriate grades

d. Development and writing of typical plans for teaching
e. The utilization of local and general economic studies for normal application
f. Observation and discussion of typical lessons in the grades showing concrete applications of the principles developed
g. The place of games and other recreational devices in grade number work

B. The historical development of the teaching of arithmetic and the place value of certain 'method', such as those of Pestalozzi and Grube

3. That every school engaged in the preparation of teachers of mathematics should develop a museum of materials, apparatus, books, pamphlets, papers, which will aid in interpreting such features as the historic development of the subject, the present day practice, and the nature of the textbooks

4. That the head of the department of mathematics should be largely responsible for the organization of the course of study in mathematics in the training school, in cooperation with the department of education and the supervision of the training school

5. That the head of the department of mathematics should aid in the supervision of the training of mathematics in the training school

6. That the head of the department of mathematics, as well as the critic teacher, should give a demonstration lesson in the training school, illustrating the principles of teaching, developed in the methods class.

7. That the amount of emphasis in all observation, discussion, written plans, and criticism should be upon the basis of fundamental principles rather than upon devices or petty details.[21]

The United States Office of Education was instrumental in the organization of the National Survey of the Education of Teachers in 1933. This group presented the following recommendations:

1. A four-year curriculum for future elementary teachers should be required as soon as possible because:
   a. The elementary teacher is deficient in his general education
   b. He has to be prepared to teach in a larger range of subjects than the high school teacher

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[21] U. S. Bureau of Education, International Commission on the Teaching of Elementary Mathematics, Bulletin No. 13 (Washington: U. S. Government Printing Office, 1911), pp. 43-44.

c. His activities with smaller and more immature children are more complex and varied
d. Recent trends require greater versatility and adaptation with constant drain upon informational resources outside of present textbooks

2. So far as teaching needs of elementary teachers are concerned, the subject major could be minimized if not omitted, and general education emphasized. So far as more intensive insight into one field is concerned in the general education of any person, the elementary teacher needs it too. It may be, however, that a major in education and psychology will supply it.

3. Detailed professional treatment of the content and method of the common branches should be stressed, particularly arithmetic, English, geography, health, home training, industrial arts, music, science, and social studies. Special adaptations for the work of the elementary teacher must be provided in these subjects in substantial amount beyond the ordinary courses offered for general education in classes in which elementary teachers are segregated to study these problems. These courses correspond to special methods courses in the secondary teaching field. The number for the elementary teacher indicates a much greater emphasis on these courses.

4. Specialization for intermediate, primary, and upper-grades may be done through specialization courses within a general curriculum in elementary education.

5. Four-year colleges and universities with inadequate facilities for specialization in elementary education including practice teaching and demonstration facilities and differential general curricula for elementary teachers, ought not to undertake the preparation of elementary teachers. Short term curricula should be abolished. In general, the standard for elementary teacher preparation in its more specialized features, though well done in many cases, is often not so well done as in education of secondary teachers.

6. Junior colleges should soon give up preparing short-term one or two year elementary teachers.

7. More intimate treatment of educational psychology for elementary teachers is needed.[22]

One of the outstanding recent studies was the Second Report of the Commission on Post-War Plant. This report was very specific on the requirements in regard to the education of elementary teachers:

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[22] U. S. Office of Education, National Survey of the Education of Teachers, Bulletin No. 10 (Washington, D. C.: U. S. Government Printing Office, 1935), p. 517.

> At some point in their education, prospective teachers of grade 1 to 6 need to learn a good deal about the nature of our decimal number system and the story of its development, the evolution of fractional notation, the theory of fundamental operations with whole numbers, fractions, and decimals, and the rationale and history of computation. Steps need also to be taken to assure equivalent preparation in order that they realize the social aim as well. It is possible to know mathematics as a closed system of ideas and skills without being able to apply it.
>
> Teachers of grades 1-6 who know mathematics in this narrow way are insensitive to the contributions of arithmetic to social progress and to sound and effective individual adjustment in our present culture. The course in the teaching of arithmetic should remove this deficiency. It can do so if the topics mentioned are treated with respect to their social implications and if the students are encouraged to note systematically the applications of mathematical concepts and the procedures to everyday life.
>
> Many teachers in our elementary schools do not as yet have four years of training in college. The better school systems employ only college graduates. If you are planning to teach in the elementary school, three things are very important: (1) a good methods course; (2) at least one course which will give you subject-matter background for the mathematics taught in grades one through six; (3) at least one course that will give you subject-matter background for teaching the general mathematics of grades seven and eight. Junior high school teachers of mathematics should have at least a minor in college mathematics.[23]

In 1947 the President's Scientific Research Board, Manpower for Research, specified:

> The selected recommendation which deals with the education of the elementary school teacher briefly states that the four year college course of the potential elementary teacher include six semester hours of biological science and six semester hours of physical science, each with professionalized laboratory work, and a professional subject matter course in arithmetic. Teachers of seventh and eighth

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[23] Second Report of the Commission on Post-War Plans, "Education of Teachers of Mathematics," The Mathematics Teacher (May, 1945), p. 215.

grade mathematics and general science should meet the requirements for certification in the secondary schools.[24]

Most of the reports of agencies on the mathematical education of prospective teachers of arithmetic have been concerned with means of obtaining those objectives which are valuable to prospective elementary school teachers. The reports investigated agree that the mathematical education of prospective elementary school teachers has been inadequate. The reader may be impressed by the great differential that exists between these reports and the state and institution requirements as reported in the previous section.

Education Department versus Mathematics Department in the Education of Elementary Arithmetic Teachers

A survey of the literature written on the education of elementary arithmetic teachers reveals that educationists and mathematicians are not in agreement on a curriculum for prospective elementary arithmetic teachers.

Bata expressed an interesting account of this controversy in the following quotation:

> A study of the reform movement in mathematics shows that during the first thirty years of its existence — roughly from 1893 to 1923 — the reconstruction of mathematics was controlled mainly by mathematical leaders. Since then, the 'educators' and administrators have increasingly dominated the scene. It appears that each of these groups has a weighty share in bringing on the present crisis. Briefly the mathematicians tried to build an imposing edifice, but only too often forgot to take into account the educational problems of the school. The educationist

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[24] The President's Scientific Research Board, "Manpower for Research," School Life, XXX (March, 1948), 20-21.

> fell into the opposite error, that of glorifying the pupil but proceeding to forget mathematics. Hence it should be perfectly obvious that during the period that lies ahead of us we must correct this dual blunder by devising a program which shall give due recognition both to mathematics and to the learner.[25]

Hedrick was very emphatic in his condemnation of the practices which are a result of the influences of educationists:

> This sin, the employment by thousands of teachers in mathematics who are untrained in mathematics, lies at the door of educationists. State laws of certification of teachers do not require that the applicant teach subjects which he has studied. . . . The acceptance of teachers untrained in the subjects to be taught comports badly with the established educational doctrine that interest in the thing studied is a prime requisite for the learning process. Yet we tolerate teachers of many a subject, and in particular mathematics, who have definitely shown by their own avoidance of it in their college training, that they themselves are not interested in it.[26]

The following quotation which deals with the reason for the employment of untrained arithmetic teachers could well have come from the pens of hundreds of mathematicians; however, it was taken from an article written by P. B. Jacobson, Superintendent of Schools, Davenport, Iowa, and Glen G. Eye, Principal of Wisconsin High School, The University of Wisconsin.

> Administrators who do not have extensive training or teaching experience in the field of mathematics tend to possess an over-simplified concept of the fundamentals of mathematics. The 'fundamental operations' are thought to be the same as the 'fundamentals of mathematics.' This

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[25] William Betz, "The Teaching and Learning Processes in Mathematics," The Mathematics Teacher, XLII (January, 1949), 49.

[26] E. R. Hedrick, "Desirable Cooperation Between Education and Mathematics," School and Society, XXXVI (December, 1932), 772.

concept has its counterpart in the field of English when it is assumed that facility in saying words constitutes reading.[27]

The important issue of securing cooperation between departments is not going to be settled by each trying to write the most unfavorable criticism. Some of the attitudes which exist between departments in institutions included in this study will be summarized in the section devoted to comments.

Conclusions

The summary of the recommendations of these reports dealing with the preparation of teachers of elementary school arithmetic has been made in order to clarify the work already completed and to arrive at a standard to use in the evaluation of the mathematical programs in the selected institutions in the Southeast.

1. The 1911 report of the International Commission recommended: (1) two and one-half years of high school mathematics as a prerequisite for entrance to the elementary program, (2) a minimum of one-half year of the professional study of arithmetic, and (3) active participation of the head of the mathematics department in the intern program designed for prospective teachers of elementary arithmetic.

2. The National Survey of the Education of Teachers made in 1933 recommended: (1) a four-year curriculum for future elementary teachers, (2) the minimizing of majors in subject matter in favor of general edu-

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[27] P. B. Jacobson and Glen G. Eye, "An Interpretation for Administrators," The North Central Association Quarterly, XXI (April, 1947), 469.

cation, (3) professional treatment of the content and the method of the common branches of subject material, (4) specialization to be handled in the general curriculum in the elementary education, and (5) only constitutions with adequate facilities for specialization should attempt the education of elementary teachers.

3. The Post-War Plans Commission recommended: (1) four-year course, (2) a good methods course in arithmetic, (3) a content course for subject matter taught in grades I to VI and (4) at least one course for grades seven and eight.

4. The President's Scientific Research Board specified: (1) four-year course and (2) a professional subject matter course in arithmetic.

5. Layton's study contained the following recommendations: (1) a four-year course, (2) a minimum of six semester hours in content mathematics, and (3) one course of general methods of teaching.

6. Robinson found that the median of clock hours in the selected institutions was in the neighborhood of thirty-six to forty clock hours. The conclusions were that the content was not sufficient. The teachers suggested 50 per cent more time needed.

7. Taylor, as a result of his studies, recommended not less than eight semester hours of mathematics.

8. Glennon's findings offered factual support for the recommendations made in the report of the Commission on Post-War Plans.

9. Reports from curriculum groups showed that elementary teachers are not in agreement on philosophy, aims, modes of learning, and practices in the teaching of arithmetic.

10. Educationists and mathematicians are unable to agree on the curriculum which should be prescribed for prospective arithmetic teachers. Two questions are always paramount, namely, Who should be in charge of the required courses? And should the emphasis be on content or methods?

CHAPTER III

PROCEDURES FOR SECURING DATA

The basic purpose of the study having been reached, it was necessary to determine where the information might be secured. It seems desirable, at the risk of some repetition, to re-state the purpose of this study; namely, an analysis of the programs for the mathematical preparation of prospective elementary school teachers in teacher education institutions in the Southeastern states.

The programs set up for the education of prospective elementary teachers in the various educational institutions are dependent upon the certification requirements of the states involved and the requirements which the respective institutions deem necessary and desirable for certification or for degrees in elementary education.

In order to analyze the requirements of the individual institutions, it is necessary to determine (1) the hours of mathematics content as well as methods in the teaching of arithmetic required for recommendation for certification or for a degree in elementary education, (2) the concepts and processes taught in the mathematics content courses to prospective elementary teachers, (3) the types of experiences offered in the methods of teaching arithmetic courses, and (4) in-service education programs provided for elementary arithmetic teachers.

Sources of Data

The information dealing with the semester hour requirements in arithmetic education could be secured from the catalogs of the insti-

tutions involved; however, the information on content of courses is much more involved. Courses which have the same number of hours and similar titles will vary in content because of variable factors such as available facilities, previous mathematical preparation of the students, abilities of the instructors involved, and the aims and philosophies of the schools and instructors. This information must come from the individual staff members involved in the programs for the education of elementary teachers.

A survey of the work which has been written in the field provides a set of standards to use in the summarization, evaluation, and recommendations. This information was secured from the literature.

Methods of Securing Data

The information on state certification requirements is a matter of record with the certification officers in the various state departments of education. Copies of the certification requirements were secured from the states included in this study. Catalogs of the institutions were secured from the registrars of the institutions studied. The information involved in the programs of the individual four-year institutions was secured through personal interview and the information was recorded on a check-list. The information from the junior colleges was secured by questionnaires.

One of the reasons the interview method of securing the information from the four-year institutions was selected in preference to less personal procedures was that the programs which had been set up for the

education of prospective elementary arithmetic teachers were very complex. The diversification of the programs can be illustrated by a brief outline of two programs:

In institution A, twenty-one students in 1948-49 received their degrees with a major in elementary education. There were no formal courses in either mathematics content or methods of teaching arithmetic. From five to six hours of individual conferences per week for a semester were held between the director and each student. Through these conferences the director determined the mathematics and science deficiencies and needs of each freshman. A laboratory work shop was held for one semester during the sophomore year to handle the individual needs in mathematics and science education. A survey was made of all students during the second semester of the sophomore year to eliminate those who did not meet the required standards.

In institution B, 182 students satisfied the requirements in 1948-49 for a degree in elementary education. In this institution, all freshmen must meet the requirements of the general college. One of the requirements was the successful completion of a mathematics content examination. All students who failed this examination were required to take a three quarter-hour course in Introduction to Mathematics which was under the supervision of the mathematics department. Last year 84 per cent of the freshmen were required to take the course because of their low scores on the entrance examination. At the end of the course, they were again given the entrance examination. This continued until the student passed the test or dropped out of the university.

Upon being admitted to the curriculum which leads to a degree with a major in elementary education, the student was required to take a general methods course. This was a four quarter-hour course in which approximately fourteen clock hours were spent on the methods of teaching arithmetic. This course was under the supervision of the education department. In addition to these required courses, Arithmetic in the Elementary Schools was offered as an elective course.

A reply blank for securing the desired information about programs which were as diversified as these two would have been so lengthy and involved that few would have taken the time to fill it out. Many of the questions would not have applied to individual schools. This would have led to a sketchy completion of the entire blank with the result that much of the desired data would have been omitted. Such results would have been unreliable. In addition, people are much more willing to devote time to an interview than they are to filling out a questionnaire.

There are other advantages to the interview method which were considered in selecting this means of collecting the data. People generally do not want to put confidential information in writing; they may want to see who is getting the information and receive a guarantee as to how it is to be used; they need the stimulation of personal contact to motivate them in providing the information. Furthermore, the interview enables the worker to follow up leads and take advantages of small clues which are necessary in dealing with complex material. The interview affords an opportunity for the interviewer to give information which will

clarify the issues involved.

Selection of Institutions to Be Included in the Study

Once the procedure for securing the data had been determined, the next step in the study was to select the institutions which were to be included. The time and resources for conducting this study were limited; consequently, the danger of attempting more than could be completely carried out had to be recognized. The territory to be covered was limited to the following nine Southeastern states: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia. Although great differences exist in the educational opportunities offered by these states, they do have many economic political, racial, and social problems in common.

The institutions included in the study consisted of all of the state universities and a sampling of all other types of four-year institutions that educated elementary teachers. The institutions, other than the state universities, were selected on the basis of (1) the number of elementary teachers graduating in 1949-50, (2) willingness of the institution to participate in the study, and (3) location of the institution with respect to a planned route of travel.

A letter was mailed to each of the 205 white and negro four-year institutions which are listed in Education Directory Higher Education published by the Office of Education in 1949. These letters were used in an effort to determine if the institutions had programs for the number of students who would complete a prescribed elementary course

between June 15, 1949 and June 15, 1950. One hundred sixty-three institutions, or approximately 80 per cent, responded to the initial letter. The 135 white schools that did report enrolled 90.1 per cent of the total white students in all of four-year colleges and universities in the nine Southeastern states. The twenty-eight negro schools which reported represented 65.9 per cent of the total negro students enrolled in four-year colleges in the same region. Of the schools which responded, forty-three reported that they did not educate elementary teachers.

Of the 120 responding institutions which educate elementary teachers, seven of the white institutions did not furnish information on the number of graduates that completed a prescribed course in elementary education. Fifty -- thirty-eight white and twelve negro -- institutions were included in this study. These fifty selected institutions educated 67.9 per cent of the white elementary teachers and 67.0 per cent of the negro elementary teachers that were reported by the responding institutions.

Table I contains the number of students completing prescribed courses in elementary education in eighty-five white and twenty-eight negro institutions between June 15, 1949 and June 15, 1950; Table I also contains the number and per cent of these teachers that were included in the study.

Only one school out of the 163 that responded to the initial letter refused to cooperate in the study. The reason given was the lack of staff and time.

TABLE I

Number of Elementary Teachers who Completed a Prescribed Elementary Education Course in 85* White and 28 Negro Institutions

	Length of Course in Years			Total
	2	3	4	
Number of White Students Reported in 85 Institutions	590	34	2564	3188
Number of White Students Reported in 38 Institutions Studied	370	0	1796	2166
Per Cent of White Students Included in the Study	62.7	0	70.9	67.9
Number of Negro Students Reported in 28 Institutions	9	25	1224	1258
Number of Negro Students Reported in 12 Institutions Studied	8	0	735	843
Per Cent of Negro Students Included in the Study	88.9	0	60.0	67.0

*Seven of the white institutions that reported elementary education programs did not furnish the number of students that completed a prescribed elementary education course.

The schools were so grouped that it was possible to contact them by traveling 5600 miles. This mileage included the pilot study as well as some back-tracking that was necessary in order to see particular individuals who were not available on the first call. A map showing the location of the institutions follows on page 39.

The criteria led to the selection of the following fifty participants:

CHART I

Location of Institutions Included in This Study

1. Agricultural and Industrial State College, Nashville, Tennessee
2. Alabama Polytechnic Institute, Auburn, Alabama
3. Albany State College, Albany, Georgia
4. Berea College, Berea, Kentucky
5. Bethel College, McKenzie, Tennessee
6. Claflin College, Orangeburg, South Carolina
7. David Lipscomb College, Nashville, Tennessee
8. Eastern Kentucky State College, Richmond, Kentucky
9. Florida Agricultural and Mechanical College, Tallahassee, Florida
10. Florida State University, Tallahassee, Florida
11. George Peabody College for Teachers, Nashville, Tennessee
12. Georgia State College for Women, Milledgeville, Georgia
13. Georgia State Womans College, Valdosta, Georgia
14. High Point College, High Point, North Carolina
15. Kentucky State College, Frankfort, Kentucky
16. Kentucky Wesleyan College, Winchester, Kentucky
17. Le Moyne College, Memphis, Tennessee
18. Limestone College, Gaffney, South Carolina
19. Longwood College, Farmville, Virginia
20. Madison College, Harrisonburg, Virginia
21. Mary Baldwin College, Stauton, Virginia
22. Memphis State College, Memphis Tennessee
23. Mercer University, Macon Georgia
24. Meredith College, Raleigh, North Carolina
25. Middle Tennessee State College, Murfreesboro, Tennessee
26. Mississippi Southern College, Hattiesburg, Mississippi
27. Mississippi State College, State College, Mississippi
28. Mississippi State College for Women, Columbus, Mississippi
29. Mississippi Woman's College, Hattiesburg, Mississippi
30. Murray State College, Murray, Kentucky
31. Salem College, Winston-Salem, North Carolina
32. Shaw University, Raleigh, North Carolina
33. State Colored Norman, Industrial, Agricultural, and Mechanical College, Orangeburg, South Carolina
34. State Teachers College, Montgomery Alabama
35. State Teachers College, Troy, Alabama
36. Tuskegee Institute, Tuskegee, Alabama
37. University of Alabama, University, Alabama
38. University of Florida, Gainesville, Florida
39. University of Georgia, Athens, Georgia
40. University of Kentucky, Lexington, Kentucky
41. University of Mississippi, University, Mississippi
42. University of North Carolina, Chapel Hill, North Carolina
43. University of South Carolina, Columbia, South Carolina
44. University of Tennessee, Knoxville, Tennessee
45. University of Virginia, Charlottesville, Virginia
46. Virginia State College, Petersburg, Virginia
47. Western Kentucky State College, Bowling Green, Kentucky
48. Winston-Salem Teachers College, Winston-Salem, North Carolina
49. Winthrop College, Rock Hill, South Carolina
50. Woman's College of University of North Carolina, Greensboro, N. Car.

Classified according to type,[1] this list includes nine teachers colleges, eight publicly controlled and one privately controlled; eighteen colleges of liberal arts, eight publicly controlled, ten privately controlled; and eleven universities, all but one publicly controlled; eight negro colleges, six publicly controlled and two privately controlled; one privately controlled negro university; two publicly controlled negro teachers colleges and one privately controlled negro technical school. This selection includes every state university and every other type of four-year institution.

Description of Check-List

Having decided on the purpose and method of securing the data from the four-year institutions, it seemed desirable to construct a check-list to use in the interview. The chief purpose of the check-list was to call attention to various aspects of the problems so that no significant material would be overlooked. The check-list[2] which was finally used in this study consisted of eight parts. A brief discussion of each part follows:

Part I: General Information. The purpose of Part I was to aid in the identification and classification of the institution and to serve as a background for the interview. The information to be filled in included the date, name of institution, location, enrollment, number of students completing each of the different courses, and the names of the

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[1] Classified according to Education Directory Higher Education, Federal Security Agency, Office of Education, 1949-50.

[2] A complete copy of this check-list is included in Appendix B.

of the individuals interviewed. All of this information was to be filled in before contacting the staff for the interview. It was decided that in the interest of accuracy the interviewer should verify the information which was taken from the Education Directory Higher Education and from the initial letter which the institution provided.

Part II: Types of Programs Offered. It is here that the different types of programs listed in terms of years required for completion were recorded. All content and methods courses in mathematics which the institution offered that were suitable for elementary teachers were also listed in this part and designated as required or elective.

Part III: Organization. Four distinct ideas were discussed and the responses recorded under Part III. These can be illustrated by the following four questions: (1) Is the mathematical education under the supervision of the mathematics or education department, or both? (2) Is the basic mathematics required a general college requirement or is it a requirement provided especially for elementary teachers? (3) Who is responsible for the mathematical requirements for the different programs? Are the institutions providing programs which meet the minimum state requirements or have they developed programs which are designed to fit the individual needs? (4) Does each student have a faculty advisor to aid him in the selection of his courses?

Part IV: Selectivity of Students. In part IV an attempt was made to determine the mathematical background of the students who were planning to major in elementary education. Provisions were made to record

the high school mathematics required for admission, the discussion of entrance examinations in mathematics, the availability of results from state-wide tests given to high school seniors, and the description of any refresher courses in mathematics required of those who had deficiencies in mathematics.

Part V: Detailed Outline of the Work Offered in Methods of Teaching Arithmetic. Part V consisted of three main divisions: (1) general information dealing with methods of teaching arithmetic, (2) a check-list of the topics usually treated in a methods of teaching of arithmetic, and (3) a check-list of available supplementary texts on the methods of teaching arithmetic. In the first division, provision was made to record the answers to these questions: (1) Is there a separate course for methods of teaching of arithmetic? (2) If there is not a separate course, what subjects are combined? (3) How much time is allocated to methods of teaching arithmetic? (4) How much credit is assigned to the course? (5) Is the course required of all prospective elementary teachers? (6) How much education and experience has the instructor had in elementary education? (7) What text is used in the course? and (8) What comments does the instructor have on the course? The check-list of topics and reference materials were provided for the convenience of the instructor of the course. These were not to be used in cases where a syllabus and outline of supplementary material or bibliography were available.

Part VI: Content of Mathematics Courses Suitable for Elementary Teachers. (This section was checked from information secured from the

mathematics departments). Provision was made for listing the mathematics courses which the institutions offer that were suitable for elementary teachers. The suitability was based on the popularity of the courses with prospective elementary teachers. In addition to the names of the courses, the credits assigned to each, the texts, and their authors were also checked.

Part VII: Detailed Syllabi of All Mathematics Content Courses That Were Not Listed under Conventional Titles. If a syllabus was available, a check-list which contained 165 items was provided for the convenience of the instructor.

Part VIII: Summary. The final part of the check-list was developed with the idea of getting evaluations and comments concerning the programs. The leading questions in the summary dealt with follow-up work executed to determine success of the teachers, special in-service education provided in the field of mathematics, standardized tests used at the end of program, and the personal satisfaction shown in the program as a whole. Space was provided for comments and evaluation.

Description of the Questionnaire Sent to Junior Colleges

In the nine states located in the Southeast, there are ninety-five junior colleges. A study of the education of prospective teachers in this region would not be complete without taking into consideration the programs offered in these junior colleges. Six of the nine states offer a certificate to teach in the elementary schools on the basis of two

years of college education. Since the programs of the junior colleges are not as involved as the programs in the four-year institutions, it was decided to make a questionnaire study of their programs.

The questionnaire[3] was designed to secure the following information:

1. The number of students that will have completed their elementary education in the junior colleges from June 15, 1949 to June 15, 1950

2. The content mathematics courses offered to and required of the prospective elementary teachers

3. The courses offered in the methods of teaching arithmetic

4. The high school prerequisite mathematics courses required for admission to the elementary program

5. The use of mathematics entrance examination

6. Refresher courses offered in mathematics

7. Comments of instructors on the adequacy of the mathematics program

8. What the staff members who are teaching in the junior colleges would consider an ideal program.

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[3] A copy of the questionnaire is enclosed in the appendix.

CHAPTER IV

ANALYSIS OF THE ARITHMETIC REQUIREMENTS FOR CERTIFICATION OF TEACHERS FOR GRADES I THROUGH VI IN THE NINE SOUTHEASTERN STATES

There are great differences among the Southeastern states in regard to the arithmetic requirements for certification of elementary teachers. These differences exist not only among the states but in the requirements among the institutions within the respective states. Some educators seem to feel that the lack of adequate, uniform certification laws has been the chief cause contributing to the poor instruction in arithmetic.

An analysis was made of the certification bulletins provided by the nine state departments of education to determine the requirements for the different types of certificates in the following: (1) the number of hours of college credit, (2) the number of hours in mathematics content, and (3) the number of hours in the methods of teaching arithmetic.

The number of hours of college credit demanded by the certification laws was important in studying the role of the junior colleges in the education of elementary teachers. In those states which grant a teaching certificate upon the completion of sixty semester hours or less of college credit, the junior college can participate in a terminal program for the education of elementary teachers. In the other states the junior college may offer either a program of general education or a part of the specialized education of the four-year institution.

The mathematics content and methods specified in the state certification requirements have been noted in this study in order to determine

(1) if there was a tendency for a greater amount of arithmetic to be taught in the institutions of those states that specified content and/or methods in arithmetic as a certification requirement; (2) if there was a tendency for the programs in arithmetic education to follow state certification requirements rather than programs planned by the staffs in charge; (3) if there was an agreement among the Southeastern states in the amount of mathematics required of prospective elementary teachers; (4) if there have been any noticeable changes as compared with previous studies.

The requirements in terms of semester hours of the teaching of materials and methods for each of the various certificates are included in this study. An effort was made to determine if the inclusion of general methods and materials in the certification requirements contributed to the mathematical preparation of prospective elementary arithmetic teachers.

Table II lists the elementary certificates issued by the nine states that were included in this study.[1] In column two the minimum college requirements for the various certificates are listed in terms of semester hours, years, or degrees as listed in the 1949-50 bulletins. The number of semester hours of content mathematics required for the various certificates are recorded in the third column. The hours marked with asterisks permit mathematics as a choice between two or more required content subjects. The requirements in mathematics methods and general methods as specified for the different certificates are listed in columns four and five, respectively.

[1]Information secured from bulletins issued by certification officers in 1949-50.

TABLE II

Requirements for Elementary School Teaching Certificates in the Southeastern States

State - Certificate	Total College	Content Math.	Math. Methods	General Methods
Alabama				
Class C	3 years	0	0	4-8
Class B	4 years	0	0	4-8
Class A	Master's	0	0	4-8
Florida				
Emergency	None	0	0	0
Temporary	1 year	0	0	0
Provisional Undergraduate	2 years	8*	0	3
Graduate	Bachelor's	8*	0	2
Provisional Graduate	Bachelor's	8*	0	2
Post Graduate	Master's or 36 hours graduate work	8*	0	2
Advanced Post Graduate	Doctor's or approved 36 hours graduate work beyond Master's	8*	0	2
Georgia				
Provisional	2 or 3 years	0	0	2-4
Professional	Bachelor's	0	0	2-4
Life Professional	Bachelor's	0	0	2-4
Kentucky				
Provisional	2 years	0	3	4
Standard	Bachelor's	0	3	4
Mississippi				
Permit - Class F	6 hours	0	0	0
Permit - Class E	30 hours	4*	0	0
Class D	60 hours	7*	0	0
Class C	90 hours	7*	0	0
Class B	Bachelor's	7*	0	**
Class A	Bachelor's plus 30 hours	7*	0	**

TABLE II (Con't)

Requirements for Elementary School Teaching Certificates in the Southeastern States

State - Certificate	Total College	Content Math.	Math. Methods	General Methods
North Carolina				
Class A	Bachelor's	0	0	0
South Carolina				
Group 1 - Class 1	Master's	0	0	0
Class 3	Bachelor's	0	0	0
Class 4	60 hours	0	0	0
Group 2 Class 2	Bachelor's plus 18 hours	0	0	0
Class 1	Master's	0	0	0
Class 3	Bachelor's plus 6 hours	0	0	0
Class 4	2 years plus 6 hours	0	0	0
Group 3 - Class 1 Adv.	Doctor's	0	0	0
Class 1	Master's	0	0	0
Class 2	Bachelor's plus 18 hrs.	0	0	0
Class 3	Bachelor's plus 6 hours	0	0	0
Group 4 - Class 1 Adv.	Doctor's	0	0	0
Class 1	Master's	0	0	0
Class 2	Bachelor's plus 18 hrs.	0	0	0
Class 3	Bachelor's plus 6 hours	0	0	0
Emergency permits	none	0	0	0
Tennessee				
Permanent Professional	2 years	3	0	9
Virginia				
Collegiate Professional	Bachelor's	0	0	0
Collegiate	Bachelor's	0	0	0

*Offer mathematics as a choice between two or more required content subjects.

**General methods required but hours not specified.

Description of Certificates for Teachers in the Elementary Schools

The following outline gives a brief description of the certificates available for elementary teachers in the nine states included in this study. The information was secured from the bulletins which were sent out by the certification officers for 1949-50. The descriptions are not complete. They deal only with the items that are pertinent to this study, namely, the minimum college work required, the number of hours of content mathematics specified for each certificate, and the number of hours of methods of teaching arithmetic and general methods required for each certificate.

Alabama

Elementary Professional Certificate -- Class C

College credit required -- Completion of an approved three-year program for the education of elementary teachers. The applicant must have the minimum rank of a senior at the institution that submits the transcript of credits.
Content courses required -- Fifty-three quarter hours of designated subject matter (no reference is made to mathematics).
Methods courses required -- Six to twelve quarter hours of general materials and methods.

Elementary Professional Certificate -- Class B

College credit required -- Completion of four years of college work including a degree in elementary education.
Content courses required -- Same as for Class C.
Methods courses required -- Same as for Class C.

Elementary Professional Certificate -- Class A

College credit required -- Master's degree from an approved college or university in an approved curriculum for the education of elementary teachers with a major either in elementary education or an approved academic field.
Content courses required -- In addition to the requirements for Class C

certificate, the candidate is to select twenty quarter hours from elementary education or from approved academic fields.
Methods courses required — Same as for Class C.

Florida

Emergency Certificate

College credit required — No formal requirements. Certificate granted upon recommendation of county superintendent when no applicant properly educated and certificated is available.

Temporary Certificate

College credit required — Certificate granted on thirty semester hours of credit from an accredited or non-accredited institution.
Courses required — State Department of Education handles each case separately in determining eligibility.

Provisional Undergraduate Certificate

College credit required — Sixty semester hours from a standard institution.
Content courses required — Total of thirty semester hours from four areas with at least eight each in arts of communication, social studies, and science and mathematics.
Methods courses required — Six semester hours Teaching in Elementary School and three semester hours materials for use with children.

Graduate Certificate

College credit required — Four year graduate from a standard institution.
Content courses required — A total of forty-five semester hours from five areas with at least eight hours in science and mathematics.
Methods courses required — Six semester hours Teaching in Elementary Schools, two semester hours Special Methods in Elementary Schools. A total of twenty-seven semester hours in specialization requirements must be completed in five areas, one of which deals with materials for use with children.

Provisional Graduate Certificate

College credit required — Four-year graduate from a standard institution
Content courses required — A total of thirty-nine semester hours from five areas with at least eight in science and mathematics.
Methods courses required — Same as requirements for graduate certificate except requirement in specialization which is limited to twenty-one semester hours in five areas.

Post Graduate Certificate

College credit required — Master's degree or an approved program of thirty-six semester hours from a standard institution.
Content and methods courses required — Same as for the Graduate Certificate.

Advanced Post Graduate Certificate

College credit required — Earned doctor's degree or an approved program of thirty-six semester hours beyond master's degree from a standard institution.
Content and methods courses required — Same as for the Graduate Certificate.

Georgia

Provisional Elementary Certificate

College credit required — Two or three years.
Content courses required — A transcript which approximates half of the total credit in academic fields including English, social science, natural science, mathematics and the humanities. From twenty to thirty semester hours is to be taken in specialization subject matter for the elementary teacher.
Methods courses required — Functional courses of from six to twelve semester hours are to be selected from three areas of which Materials and Methods in the Elementary Grades is listed as one.

Professional Elementary Certificate

College credit required — Professional four-year curriculum including bachelor's degree.
Content and methods courses required — Same as for the Provisional Elementary Certificate.

The Life Professional Certificate

Granted to holders of Professional Certificate after six years of successful experience as a teacher.

Kentucky

Provisional Elementary Certificate

College credit required — Two years of college work.
Content courses required — Thirty-four semester hours of designated content material (no reference is made to mathematics).

Methods courses required — Seventeen semester hours of professional education which includes six semester hours of Teaching Reading and Arithmetic and four semester hours of materials and methods in elementary education.

Standard Elementary Certificate

College credit required — Bachelor's degree.
Content courses required — Seventy-one semester hours of designated content material (no reference is made to mathematics).
Methods courses required — Twenty-eight semester hours of professional education which includes six semester hours of Techniques of Teaching Reading and Arithmetic and four semester hours of materials and methods in elementary education.

Mississippi

Permit of Employment — Class F

College credit required — Six semester hours in any field.

Permit of Employment — Class E

College credit required — Thirty semester hours.
Content courses required — Twelve semester hours from forty-nine designated semester hours which includes six semester hours of physical science, four of which may be mathematics.
Methods courses required — Six semester hours from twenty-four designated semester hours in professional education which includes principles and techniques of teaching.

Class D Elementary School Certificate

College credit required — Sixty semester hours.
Content courses required — Twenty-one semester hours from forty-nine designated semester hours which includes six semester hours of physical science, four of which may be mathematics; eighteen semester hours from a designated twenty-four semester hours of specialized education which includes three hours of arithmetic for children.
Methods courses required — Twelve semester hours from a designated group of twenty-four semester hours of professional education which includes principles and techniques of teaching.

Class C Elementary Certificate

College credit required — Ninety semester hours.
Content courses required — Thirty semester hours from forty-nine designated semester hours which includes six semester hours of physical science, four of which may be mathematics; eighteen semester hours of

specialized education which includes three hours of arithmetic for children.
Methods courses required — Eighteen semester hours from a designated group of twenty-four semester hours in professional education which includes principles and techniques of teaching.

Class B Elementary Certificate

College credit required — Bachelor's degree from an approved teacher-education institution.
Content courses required — Forty-nine semester hours of designated general education courses which includes six semester hours of physical science, four of which may be mathematics; twenty-four hours of designated specialized education which includes three semester hours of arithmetic for children.
Methods courses required — Twenty-four hours of designated professional education which includes principles and techniques of teaching.

Class A Elementary Certificate

College credit required — Bachelor's degree from an approved teacher-education institution plus thirty semester hours of appropriate graduate study in courses that are acceptable toward an advanced degree.
Content and methods courses required — Same as for Class B Elementary Certificate.

North Carolina

Class A Elementary Certificate for Grammar Grade or Primary Certificate

College credit required --Bachelor's degree from a standard institution.
Content courses required — Forty-six semester hours of designated content material (no reference is made to mathematics).
Methods courses required — Eighteen semester hours of professional education (no reference is made to any methods work).

South Carolina

There are four groups of certification classifications in South Carolina which are distinguishable by the amount of in-service education and experience of the teachers in these groups. Each group is subdivided into classes and grades. The classes are determined by the amount and kind of education. The four grades are based on scores made on National Teachers Examination. All of the classes are not represented under each group.

Group one — Probationary Certificate

Class One

College credit required — Prescribed four-year program of general and professional education plus a master's degree in education or a master's degree with a major in education and a minor in the subject area of the certificate.
Content courses required — Forty-five hours of designated course work (no reference is made to mathematics).
Methods courses required — A minimum of twenty-one semester hours of professional courses which includes special methods and materials on the elementary level.

Class Three

College credit required — Bachelor's degree
Content and methods courses — Same as Group One Class One.

Class Four

College credit required — Sixty semester hours.
Content courses required — Thirty semester hours of general education plus nine semester hours of special education (no reference is made to mathematics).
Methods courses required — Fifteen semester hours of professional education which includes general techniques.

Group Two — Intermediate Professional Certificates

Class One

All requirements are the same as Group One Class One except this classification requires two years of experience.

Class Two

College credit required — Completion of the prescribed four-year program of general education plus a minimum of eighteen semester hours of graduate credit in general, professional, or special education.
Content and methods courses required — Same as Group One Class One.

Class Three

College credit required — Completion of the prescribed four-year program of general and professional education plus six semester hours of college credit in general or professional education.
Content and methods courses required — Same as Group One Class One.

Class Four

College credit required — Completion of two-year course plus six semester hours of general or professional education.
Content and methods courses required — Same as Group One Class One.

Group Three — Advanced Professional Certificates

Class One - Advanced

College credit required — An earned doctor's degree in professional education or an earned doctor's degree in education.
Content and methods courses required — Same as Group One Class One.

Class One

College credit required — Master's degree.
Content and methods courses required — Same as Group One Class One.

Class Two

College credit required — Bachelor's degree plus eighteen semester hours of graduate credit.
Content and methods courses required — Same as Group One Class One.

Class Three

College credit required — Bachelor's degree plus six semester hours of college credit.
Content and methods courses required — Same as Group One Class One.

Group Four — Permanent Professional Certificates.

There are four classes of certificates in this group, namely, Class One-Advanced, Class One, Class Two, and Class Three. The requirements are the same for these certificates as for the corresponding classes in Group Three except for the experiences required for the Permanent Professional Certificates.

Emergency Permits

There are five classes of emergency permits corresponding to the five classes of certificates. These permits are handled as individual cases.

Tennessee

Permanent Professional Certificate

College credit required — Two year curriculum for elementary teachers.

Content courses required — Seventy-two quarter hours of designated content courses which include three quarter hours of content mathematics.
Methods courses required — Eighteen quarter hours of designated professional courses which include nine hours of materials and methods in the elementary subjects.

Virginia

Collegiate Professional Certificate

College credit required — Bachelor's degree.
Content courses required — Required courses deal only with physical education and hygiene.
Methods courses required — Eighteen semester hours of professional education (no reference is made to methods.).

Collegiate Certificate

College credit required — Bachelor's degree.
Content courses required — Same as Collegiate Professional Certificate.
Methods courses required — No reference is made to any professional education.

A study of Table 2 and the statements regarding certification requirements reveals that two states granted emergency certificates without college credits. The lowest non-emergency certificates in the nine states included in this study were earned by the completion of two years of work in six of the states, three years in one, and four years in the other. Only two states required a content course in mathematics for their highest certificates and two others offered mathematics as a choice between two or more required courses. Six of the nine states required work in general methods and/or materials. One of these six specifically designated a course in the teaching of arithmetic.

There was a tendency for the certification departments of the states included in this study to require a four-year degree or higher

for the highest certificates granted prospective teachers of the elementary schools. Four of the nine states required five or more years of college work for the highest certificate issued.

Two-thirds of the states required a course in general methods of all prospective elementary teachers. Very few of the certification requirements, however, included either content mathematics or methods of teaching arithmetic.

There was a great variance in the number of types of certificates issued by the different states. One state issued only one type of certificate to all elementary teachers, while a second state issued forty-nine different classifications of elementary certificates. The medium number issued by the nine states included by this study was three.

Few changes in certification requirements for the elementary school teachers were enacted between January 1, 1947 and January 1, 1950. Layton's[2] study listed the lowest and the highest certification requirements which were in effect January 1, 1947. Upon comparison of the 1947 and 1950 data, the outstanding certification changes in the Southeast were found in Mississippi. A complete new set of rules and regulations supercede all previous regulations, but they do not affect the tenure of any certificate now valid. The certification

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[2] William I. Layton, An Analysis of Certification Requirements for Teachers of Mathematics (Nashville, Tennessee: George Peabody College for Teachers), 1949, pp. 7-53.

digest of Mississippi on page 53 gives the new regulations. Layton's study did not include the Emergency and Temporary Certificates which were in effect in Florida nor the Emergency Permit which is used in South Carolina. The revised edition of Requirements for Teacher Education and Certification of South Carolina did not include the three semester hours of general mathematics in the general education as listed by Layton.

CHAPTER V

ANALYSIS OF THE PROGRAMS DESIGNED FOR THE PREPARATION OF ARITHMETIC TEACHERS IN FOUR-YEAR INSTITUTIONS IN THE SOUTHEAST

This chapter is an analysis of the programs designed for the preparation of elementary arithmetic teachers in the fifty selected four-year institutions. It is an analysis of the information which was obtained through private interview with the school people who are engaged in the administration, supervision, and instruction of the separate programs.

The information is presented under the following headings:

1. Hour and course requirements in content mathematics and methods of teaching arithmetic for elementary education majors
    a. Admission requirements in mathematics
    b. Mathematics exemption examinations
    c. Hour requirements in content mathematics
    d. Names of content mathematics courses required and by whom selected
    e. Hour requirements in special and general methods
    f. Total hour requirements in content mathematics and methods of teaching arithmetic
2. Content mathematics courses available but not required of elementary education majors
3. Analysis of required content mathematics
    a. Names of textbooks
    b. Items treated in Arithmetic for Teachers courses
    c. Items treated in General College Mathematics courses
    d. Summary of other types of content mathematics courses
4. Analysis of the required methods of teaching arithmetic courses
    a. Basal textbooks used in methods of teaching arithmetic
    b. Analysis of content in special methods courses
    c. Analysis of content in general methods courses
    d. Education and elementary school experience of teachers of special methods courses

5. Other aspects of programs for education of elementary arithmetic teachers

   a. Selection of elementary majors
   b. In-service education of teachers
   c. Follow-up of graduates
   d. Instructors' comments on existing programs

6. Summary

Hour and Course Requirements in Content Mathematics and Methods of Teaching Arithmetic for Elementary Education Majors

Admission Requirements in Mathematics -- The following discussion deals with an analysis of the high school mathematics designated as prerequisite in the general college entrance requirements of the institutions studied. Twenty-two of the thirty-eight white institutions and seven of the twelve negro institutions studied admitted applicants who were graduates of accredited high schools without prescribing a pattern of work for admission. The mathematics courses which were prescribed are listed in Table III. The requirements are listed in units. One unit represents the study of a subject for a school year with five recitation periods a week, each of at least forty-five minutes in length, or the equivalent thereof. These entrance requirements must be met before college credit will be granted toward a degree. In many cases the students were admitted on probation and allowed to meet the requirements by taking no credit equivalent courses or by passing an equivalent examination in the subject.

The average number of units of high school prerequisites in mathematics required by the thirty-eight white institutions was .80; the average for the twelve negro instutions was .75.

TABLE III

Admission Requirements in Mathematics
in Fifty Selected Four-Year Institutions

Units — Content	Frequency	
	White	Negro
None	22	7
One		
Any mathematics	1	1
Algebra	2	0
One and one-half		
One and one-half units of algebra or one unit of algebra and one-half unit of any mathematics	1	0
Two		
Any mathematics	3	1
One unit of algebra and one unit of geometry	2	2
Two units of algebra or one unit of algebra and one unit of geometry	1	1
One unit of algebra and one unit of any mathematics	2	0
Two and one-half		
One and one-half units of algebra and one unit of geometry	3	0
One and one-half unit of algebra and one unit of any mathematics	1	0

Mathematics Exemption Examinations — The majority of the institutions studied gave general entrance examinations. These examinations were used by the advisors to aid them in their guidance work. Many of the mathematics departments gave examinations to students interested in taking courses in mathematics. These two classifications of examinations were not directly related to the mathematics education of prospective elementary teachers and therefore are not discussed in this study. The only mathematics examinations which were directly related to this problem were the examinations used to exempt students from required courses in content mathematics. Four institutions each listed such a required content mathematics course from which students could be exempt by examination. The standard of exemption in every case was flexible; the decision was left to the student's advisor. The exemptions in 1949-50 in the four institutions varied from 16 to 50 per cent of the entering freshmen. Two of the institutions used An Examination on Elementary School Mathematics by Nora D. Field. This examination was prepared in partial fulfillment of the requirements for the Degree of Master of Arts in the School of Education, University of South Carolina, 1947. One institution used A Test of General Proficiency in the Field of Mathematics (New York: Educational Testing Service), 1948. The fourth institution used a test which was produced by the staff that taught the general mathematics courses.

The concepts and skills which were tested in the exemption examinations are listed in Table IV. They have been classified under the arithmetic that is usually taught in the first six grades, junior high

TABLE IV

Concepts and Skills Tested by Exemption Examinations

TEST	Frequency A	B	C
Grades I to VI			
Computation with integers, fractions, decimals	0	1	25
Written problems (simple relationships)	1	2	11
Finding arithmetic mean	1	0	1
Interpretation of simple bar graphs	4	1	1
Junior High School			
Interpretation of line, circle, and picture graphs	9	0	0
Ratio and proportions	3	8	1
Division with zero	0	2	1
Name parts of fraction, subtraction, multiplication problems	0	0	3
Square and square roots	0	0	2
Computation with denominate numbers	1	2	5
Scientific notation	0	2	0
Understanding the number system	0	2	8
Relationship between decimals, fractions, per cents	1	1	5
Cases in percentage	0	5	5
Application of percentage to business problems	0	0	6
Interpret rate tables	10	0	0
Scale and scale drawing	3	3	2
Finding the least common denominator	1	0	1
Manipulation of simple algebraic equations	1	14	2
Computation with positive and negative numbers	2	3	2
Vocabulary of simple geometry	3	0	15
Finding simple areas and volumes	2	2	7
Identification of types of angles	2	0	2
Application of Pythagorean theorem	1	1	1
Senior High School			
Identification of extended numbers	2	1	0
Use of logarithms	1	0	0
Computation with approximate numbers	1	3	2
Meaning of reliability and logic	0	3	0

TABLE IV (Con't)

Concepts and Skills Tested by Exemption Examinations

TEST	Frequency A	B	C
Definition of purpose and place of mathematics	0	2	0
Use of exponents	1	5	0
Geometric progression	1	1	0
Interpretation and classification of algebraic expressions	5	2	2
Factoring of algebraic expressions	2	0	0
Definition of identity	0	1	0
Inductive reasoning	0	1	0
Graphing a function	2	1	0
Rationalization of fractions	1	0	0
Solution of simultaneous equations	1	0	0
Functional relationship	0	4	1
Supply parts of geometric proof	5	0	2
Introduction to geometry (parallel lines, similar triangles, locus)	6	1	2
Trigonometric functions and applications	2	1	0

school,[1] and senior high school. The lack of agreement on the concepts and skills to be tested is emphasized by Table IV. The items of the tests are listed under forty-two groups of basic concepts and skills. Of these, thirteen are covered by two of the tests and fourteen by only one of the tests.

Table V shows the per cent of the total items that were included in each of the grade classifications by the three exemption examinations.

[1] It was assumed that the junior high school mathematics included the conventional seventh and eighth grade arithmetic plus a course in general mathematics.

TABLE V

Grade Classification of Concepts and Skills

	Per Cent		
Test	Grades I to VI	Junior High	Senior High
A	8	52	40
B	5	60	35
C	33	59	8

Table V indicates that there was a great difference of opinion among the institutions on the complexity of the mathematical concepts and skills to be tested. The three tests emphasized junior high school mathematics but certainly disagreed on the amount of emphasis placed on concepts and skills of grade arithmetic and senior high school mathematics.

Hour Requirements in Content Mathematics — A course has been listed as a content course in mathematics if it dealt with the logical study of mathematical concepts and skills without any reference to methods of presentation of the material. In all but two of the institutions studied, the content mathematics was under the supervision of departments of mathematics. In the two exceptions the courses were under the supervision of departments of education but taught by instructors who had previously taught mathematics.

In order that the hour requirements in mathematics could be readily

compared, all requirements were listed in terms of semester hours. A quarter-hour of credit was converted to two-thirds of a semester hour of credit.

Table VI shows the number of semester hours of content mathematics required by the institutions included in this study. This table includes the four courses mentioned previously for which students could be exempted by examination.

TABLE VI

Hour Requirements in Content Mathematics

	Semester Hours						
	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	No Content	Total
White Inst.	9	8	0	1	3	17	38
Negro Inst.	1	4	2	1	4	0	12
Total Inst.	10	12	2	2	7	17	50

In Table VI it is revealed that seventeen or about one-half of the white institutions required no content mathematics in their programs for the education of prospective elementary teachers. Approximately two-thirds of the fifty institutions required at least one course in content mathematics. All of the institutions set up course requirements that were equal to or greater than their state requirements. Of the seventeen institutions that did not require any content mathematics, seven did not specify any high school mathematics in their entrance requirements, three required one unit, one required

one and one-half units, four required two units, and two required two and one-half units. On a basis of this information, the statement can be made that a number of students may have graduated from these institutions without enrolling in any mathematics course since they were in the grades.

Names of Content Mathematics Courses Required and by Whom Selected -- The content mathematics that was required has been classified as arithmetic for teachers, general college mathematics, algebra, trigonometry, mathematics of finance, high school mathematics, and grade arithmetic. The classification was based upon information obtained from the instructors of the courses, textbooks used, and courses of study.

TABLE VII

Classification of Content Mathematics Required

Types of Mathematics	White Institutions		Negro Institutions	
	Sem. Hrs.	No. Courses	Sem. Hrs.	No. Courses
Arithmetic for Teachers*	27.4	9	18.0	5
Gen'l College Mathematics**	13.6	5	11.3	2
Algebra	9.7	3	3.0	1
Trigonometry	6.3	2	0.0	0
Mathematics of Finance*	8.0	2	4.0	1
High School Mathematics	2.0	1	0.0	0
Grade Arithmetic	2.0	1	15.0	4
Total	69.0	23	51.3	13

*Includes one course from which students could be exempted by examination.

**Includes two courses from which students could be exempted by examination.

Table VII reveals the practice of thirty-three institutions in the selection of content mathematics. Seventeen of the institutions did not include content mathematics as a requirement for the education of their prospective elementary teachers. Of the twenty-one white institutions requiring content mathematics, nine of these specified Mathematics for Teachers as the only required course. In the case of the negro institutions five of the twelve institutions required Mathematics for Teachers, with one of the five requiring an additional course in grade arithmetic. This was an average of approximately three and seven-tenths hours of content mathematics for the schools that included content mathematics and an average of two and four-tenths hours for all of the schools studied.

Only one of the twenty-one white institutions required a course designated as grade arithmetic while this course was required of four of the twelve negro institutions. The instructors of these courses gave the following reasons for the inclusion of grade arithmetic as a college course: (1) the students had not had a previous opportunity to learn the fundamentals of arithmetic and (2) there was a great need for teachers who understood these fundamentals and experience proved that they had to start at this level.

The programs for elementary education majors have been developed over a long period of time. Many factors have influenced the types of courses which have been included. It is pertinent to this study to list the factors which were responsible for the introduction of content mathematics which was required in only 66 per cent of the programs.

TABLE VIII

Factors Responsible for Inclusion of Required Content Mathematics

Factors	Semester Hours			Per Cent		
	Total	White	Negro	Total	White	Negro
Elementary Education Faculty Committee	53.9	27.9	26.0	45	41	51
General Education Faculty Committee	44.0	25.7	18.3	37	37	35
State Requirements	16.4	13.4	3.0	13	19	6
Dean of the College	6.0	2.0	4.0	5	3	8
Total	120.3	69.0	51.3	100	100	100

It is revealed in Table VIII that 45 per cent of the semester hours of content mathematics were determined by elementary education faculty committees. This leaves 55 per cent of the content mathematics determined by other factors. It is not to be assumed that elementary education staff members disapprove the balance of the selection of the content mathematics. In fact, in many cases the elementary staff members were responsible for the introduction of content mathematics in the general education programs and the adoption of content mathematics as a part of the state certification requirements. It is revealed in Table VIII that 87 per cent of the content mathematics required by the institutions that included content courses were required by factors other than state certification requirements.

It is interesting to note the types of content mathematics selected by the different factors that were designated to make the choices.

TABLE IX

Types of Content Mathematics Selected by Factors Responsible for the Choices

	Elementary Education Faculty Committee	General Education Faculty Committee	State Requirement*	Dean
Arithmetic for Teachers	** w-3 ** n-4	w-2 n-0	w-4 n-1	w-0 n-0
General College Mathematics	w-2 n-0	w-2 n-2	w-1 n-0	w-0 n-0
Algebra	w-2 n-0	w-1 n-1	w-0 n-0	w-0 n-0
Trigonometry	w-1 n-0	w-1 n-0	w-0 n-0	w-0 n-0
Mathematics of Finance	w-0 n-0	w-2 n-1	w-0 n-0	w-0 n-0
High School Mathematics	w-0 n-0	w-0 n-0	w-0 n-0	w-1 n-0
Grade Arithmetic	w-0 n-3	w-0 n-0	w-1 n-0	w-0 n-1

*One state required a course in content mathematics; the institutions located in this state selected the type of course they wanted to meet this requirement.

**w indicates white institutions and n indicates negro institutions.

In about four-fifths of the institutions, faculty members were appointed on committees to select the required content mathematics courses. Table IX reveals that committees made up of elementary education faculty members were unable to agree on the content mathematics that should be

required. With the exception of the fourteen courses in Arithmetic for Teachers, the three courses in grade arithmetic, and one of the courses in Mathematics of Finance, the instructors indicated that they had made their selection from existing courses. The elementary education faculty committees designated seven choices out of fifteen as Arithmetic for Teachers. The general education faculty committees selected seven out of twelve courses in general college mathematics and mathematics of finance. In the few cases where state certification requirements specified mathematics content for elementary teachers, five out of seven institutions designated Arithmetic for Teachers.

Hour Requirements in Special and General Methods — The work in the methods of teaching arithmetic was offered under two different arrangements. In the one case the institutions offered courses which were devoted entirely to the methods of teaching arithmetic. These courses are referred to as special methods courses. In the other case the institutions offered work in the methods of teaching arithmetic as a part of general methods courses. These courses are referred to as general methods courses.

Forty-two of the fifty institutions included in this study required work in special and/or general courses in methods of teaching arithmetic of all elementary education majors. Fifteen of the white and six of the negro institutions required a special course in the methods of teaching arithmetic. Eighteen of the white and three of the negro institutions included methods of teaching arithmetic in a general course. The number of semester hours devoted to the methods of teaching arithmetic

(both special and general) are listed in Table X.

TABLE X

Hours Required in the Methods of Teaching Arithmetic*

	Semester Hours					
	0-.9	1-1.9	2-2.9	3-3.9	None	Total
Frequency White Inst.	14	3	5**	11***	5	38
Frequency Negro Inst.	2	1	2***	4***	3	12
Total Frequency	16	4	7	15	8	50

*The same system was used in converting quarter hours to semester hours as was explained on page 68. One clock hour of work was recorded as one-eighteenth of a semester hour.

**All of these courses except one two-semester hours course were reported in special methods.

***All of these courses were reported in special methods.

The total number of semester hours required in the methods of teaching arithmetic in the fifty institutions was 70.6. This was an average for the white institutions of 1.4 semester hours; the average for the negro institutions was 1.5 semester hours. The average per institution was 1.4 semester hours.

In Chapter IV which dealt with state certification requirements, it was revealed that Kentucky was the only state that required a course in the methods of teaching arithmetic while Alabama, Florida, Georgia, Mississippi, and Tennessee required work in general methods. Thirty-three of the studied institutions are located in the six states named above. The total work required in the methods of teaching arithmetic

in these thirty-three institutions was 47.3 semester hours. This was an average of 1.4 semester hours per institution. The average number of semester hours required in the methods of teaching arithmetic by the institutions located in the states whose certification regulations did not specify methods was also 1.4 semester hours per institution. The fact that there is no difference in these averages would seem to indicate that the state certification requirements in regard to special and general methods were so low that they did not influence the number of semester hours in the methods of teaching arithmetic required in institutions located within those states.

Total Hour Requirements in Content Mathematics and Methods of Teaching Arithmetic -- The fifty institutions included in this study required a total of 190.9 semester hours of mathematics -- content and methods -- for the completion of their programs designated for elementary majors. Table XI reveals that the requirements ranged from two-tenths of a semester hour to nine semester hours of credit in mathematics. This means that every institution included in this study required some mathematics education of their elementary majors. The average for the thirty-eight white institutions was three and two-tenths semester hours; the average for the twelve negro institutions was five and eight-tenths semester hours. Table XI summarizes these results. Included in the table are the four content courses or eleven hours for which students could be exempted by examination.

TABLE XI

Total Hour Requirements in Content Mathematics and Methods of Teaching Arithmetic

	Semester Hours			
	Total	Minimum	Maximum	Average
Thirty-eight White Institutions	121.1	.2	8.0	3.2
Twelve Negro Institutions	69.8	3.0	9.0	5.8
Total Institutions	190.9	.2	9.0	3.8

The figures in Table XII designate the number of institutions that require various amounts of semester hours credit in mathematics. Table XII shows that there was a great difference in the mathematical requirements among the various institutions. It is of interest to note the requirements according to the types of institutions studied. The institutions were classified according to type on page 41. The average number of semester hours for the different types of institutions studied are listed in Table XIII. This table reveals that there was no important difference in the average amounts of mathematics required by the different types of white institutions studied. The number of negro institutions of any one type was too few to arrive at any conclusion in regard to the relation between mathematical requirements and types of institutions.

TABLE XII

Distribution of Total Mathematics Requirements

	Semester Hours										
	0-.9	1-1.9	2-2.9	3-3.9	4-4.9	5-5.9	6-6.9	7-7.9	8-8.9	9-9.9	Total
White Inst.	5	3	7	13	4*	1	3	1	1	0	38
Negro Inst.	0	0	0	2	3	0	4	0	1	2	12
Total Inst.	5	3	7	15	7	1	7	1	2	2	50

*One institution in this group would upon recommendation of the student's advisor substitute two semester hours of credit in advanced algebra for three and three-tenths hours of credit in intermediate algebra.

TABLE XIII

Average Mathematical* Requirement According to Type of Institution

Type of Institution	Number of White Institutions	Average Mathematics Sem. Hours	Number of Negro Institutions	Average Mathematics Sem. Hours
University	11	3.3	1	3.0
Liberal Arts Col.	18	3.1	8	6.1
Teachers College	9	3.3	2	6.4
Technical College	0		1	6.8
Total	38	3.2	12	6.0

*Content and Methods combined.

Content Mathematics Courses Available but not Required of Elementary Education Majors

A study of the curriculums of fifty teacher education institutions was made to determine the amount and character of the mathematics courses required of and offered to prospective elementary teachers. All but one of the institutions offered a major in mathematics which included work at least through calculus. The one institution educated only elementary teachers and offered three courses in arithmetic for elementary teachers. A few institutions included programs which lead to a doctor's degree in mathematics. In all cases, courses offered by the mathematics departments were available to prospective elementary teachers. Information was not available as to the number of students who selected mathematics as electives. Counselors estimated the number to vary from one out of ten to less than one in a hundred. Three reasons were given for the lack of popularity of mathematics among prospective elementary teachers: first, the students did not have prerequisites required by the mathematics departments; second, the mathematics courses offered were not suitable for elementary teachers; and, third, the students had only a few electives and many different fields from which to choose them.

A brief survey of the catalogs of the fifty institutions included in this study was made to determine the courses available but not required of prospective elementary teachers. This survey revealed that twenty-two non-credit courses were offered by the mathematics departments. They were listed as remedial algebra, plane geometry, solid

geometry, elementary algebra, remedial mathematics, and basic mathematics. These courses were designed especially for students who desired to pursue further work in mathematics departments but whose proficiency in mathematics would seem to indicate probable failure in the regular courses.

Four institutions offered elective courses designated as arithmetic. In addition, many of the schools offered courses under such titles as Fundamental Mathematics, Introduction to College Mathematics, Introduction to Mathematics Analysis, and so forth. In most cases the prerequisites for these courses were one year of algebra and one year of geometry. The most common sequence offered, however, was college algebra, trigonometry, analytic geometry, and calculus. No further attempt was made to analyze the courses offered by the mathematics departments except in the cases that affected the programs of elementary education majors.

Analysis of Required Content Mathematics

Names of Textbooks — It is possible to get some indication of the topics emphasized in content mathematics by noting the books used as basal textbooks. These textbooks provided the sources of material for the content courses. The instructors of the courses emphasized the fact that they had little time available to introduce any supplementary material. The textbooks are listed in Table XIV under the same classification as appeared in the previous division of the content courses. A complete list of titles, authors, publishers, and so forth may be found in Appendix D.

TABLE XIV

Textbooks Used in Required Content Mathematics Courses

Author	Title	Frequency		
		White	Negro	Total
	Mathematics for Teachers			
Boyer	Introduction to Mathematics for Teachers	3	0	3
Buckingham	Elementary Arithmetic; Its Meaning and Practice	4	1	5
Roantree & Taylor	An Arithmetic for Teachers	0	1	1
Schlauch	Basic Arithmetic for College Students	1	0	1
Taylor & Mills	Arithmetic for Teacher Training Classes	0	3	3
Wilson et al.	Teaching the New Arithmetic	1	0	1
	General College Mathematics			
Fuller	Mathematics for Students of General Education	0	1	1
Kaltenborn	Insight into Mathematics	1	0	1
Kokomoor	Mathematics in Human Affairs	1	1	2
Newsom	Introduction to College Mathematics	1	0	1
Stephens	Fundamental Mathematics	1	0	1
Trimble et al.	Basic Mathematics for General Education	1	0	1
	Algebra			
Hart	Introduction to College Algebra	0	1	1
Peterson	College Algebra	1	0	1
Richardson	College Algebra	1	0	1
Rees and Sparks	Basic College Algebra	1	0	1
	Trigonometry			
Brink	Plane Trigonometry	1	0	1
Rickey and Cole	Plane & Spherical Trigonometry	1	0	1
	Mathematics of Finance			
Donaldson	Personal Finance	1	0	1
Simpson et al.	Mathematics of Finance	1	0	1
Snyder	Essential Business Mathematics	0	1	1
	High School Arithmetic			
Lasley and Mudd	New Applied Mathematics	1	0	1
	Grade Arithmetic			
Collection of grade arithmetic workbooks		1	4	5

The fourteen institutions that required a course designated as Arithmetic for Teachers limited their selection to six books. Five of the institutions used Buckingham's Elementary Arithmetic; Its Meaning and Practice. Three selected Boyer's Introduction to Mathematics for Teachers, and three selected Taylor and Mill's Arithmetic for Teacher-Training Classes.

Dissatisfaction with the content mathematics required of elementary education majors has been expressed by the educationists. The wide selection of textbooks would seem to indicate that the mathematicians were unable to agree on the content or approach that should be used in the required courses. Only one text, Kokomoor's Mathematics in Human Affairs, received adoption by more than one school. Five of the textbooks used in general mathematics were written by a member or members of the staff which adopted the books.

Items Treated in Required Arithmetic for Teachers Courses — Of the fifty institutions studied, fourteen required of all education majors a content course in mathematics designated Arithmetic for Teachers. This course in each of the various institutions was planned primarily for prospective elementary arithmetic teachers. The basal textbooks used are listed on page 79. In thirteen of the fourteen institutions this course was under the supervision of the mathematics department. In the one instance to the contrary, the course was taught by a staff member from an education department. Table XV lists the skills and concepts which were taught in nine white and five negro institutions that required the course Arithmetic for Teachers. The sources of information

for this table were variable and must be considered. Some of the instructors furnished a printed syllabus for their course, others checked a prepared list of items, and a third group designated sections of the texts that were to be covered in the course. An effort was made to have the instructors note any deletions or additions that were actually made in the presentation of the material. However, anyone using or evaluating this table must consider that the topics were not selected on a uniform basis. It is the opinion of the writer that the table is of value in presenting a general picture of the items that were taught, although it is understood that it does not present a picture of the amount of emphasis which was placed on the various concepts and skills.

It was emphasized in each interview that an analysis of the content of the courses was considered a very important part of this study. The instructors of the courses were very cooperative in furnishing a detailed outline of the material which they treated. The tabulation of the materials taught in the different courses consumed the major part of the time spent in the interviews in the cases where the instructors did not have a prepared syllabus. Great care was exercised in an attempt to get as complete a syllabus for each course as was possible.

The writer has classified into seven groups, namely: (1) concepts dealing with systems of numeration, (2) computation skills in arithmetic, (3) manipulation and uses of multisensory aids, (4) concepts and skills in measurement, (5) algebraic skills and concepts, (6) geometric skills and concepts, and (7) trigonometric skills and concepts. This division was not made in any syllabus or textbook examined but is

presented for convenience of classification of the items covered by the courses. The seven classifications slightly overlap; consequently, the placing of some of the items could be questioned. The frequency columns in Table XV show the number of times that each item was treated in the nine white and five negro institutions. The items are presented in descending order of their total frequency in the fourteen institutions.

Of the sixty-five concepts and skills listed, thirty-five or 54 per cent were common to at least half of the courses. The items most commonly agreed upon fell in concepts dealing with systems of numeration and computational skills in arithmetic. The least frequently mentioned items were in algebraic, geometric, and trigonometric skills and concepts.

It is apparent from Table XV that all of the schools spent time on the development of the decimal number system. Eleven of the fourteen compared number systems of the base ten, but only three discussed number systems of the base twelve. Thirteen of the fourteen spent time on the fundamental operations. A considerable amount of time was spent on problems dealing with percentage. Three of the schools treated the rules of operation of arithmetic. The number of multisensory aids used in the classrooms was definitely limited.

TABLE XV

Items Treated in Required Arithmetic for Teachers Courses

Concepts and Skills	Frequency		
	White	Negro	Total
Concepts Dealing with Systems of Numeration			
Development of our number system	9	5	14
Reading numbers	8	5	13
Rounding numbers	9	4	13
Place value	7	5	12
Positive exponents	9	3	12
Number concepts	7	4	11
Significant digits	8	2	10
Positive, zero, and negative exponents	5	2	7
Scientific notation	3	3	6
Repeating and terminal decimals	3	2	5
Duodecimal system	3	0	3
Computation Skills in Arithmetic			
Application of percentage	9	5	14
Three types of per cent problems	9	5	14
Fundamental operations with integers, fractions, and decimals	8	5	13
Relationship between fractions, decimals, and per cents	7	5	12
Square and square root	8	3	11
Ratio and proportion	8	3	11
Applications of simple formulas	6	3	9
Arithmetic mean	5	4	9
Fundamental operations with denominate numbers	5	3	8
Three types of problems with fractions	5	2	7
Suggestions for problem solving	4	3	7
Fundamental operations with approximate numbers	4	1	5
Rules for divisibility of numbers	4	1	5
Systems for finding highest common factor and least common multiple	3	1	4
Rules of operation of arithmetic (associative, commutitative, and distributive)	3	0	3
Finding cube root by division method	1	0	1
Multi-Sensory Aids Used in Classroom			
Examples of scale drawing of objects	4	5	9
Simple graphs	4	5	9
Measuring instruments	4	4	8

TABLE XV (Continued)

Concepts and Skills	Frequency White	Negro	Total
Abacus	3	0	3
Slide Rule	1	0	1
Concepts and Skills in Measurement			
Measurement of volumes	7	5	12
Measurement of areas	5	5	10
Measurement of capacity and weights	4	5	9
Common units of measurement (tables)	4	4	8
Nature of measurement	4	4	8
Measurement of time (time belts, seasons, etc.)	5	2	7
Introduction of the metric system	4	3	7
Indirect measurement	5	2	7
Measurement of angles	4	1	5
Precision in measurement	4	1	5
Algebraic Skills and Concepts			
Manipulation of equations	6	1	7
Fundamental operations with literal, positive, and negative numbers	6	1	7
Equation method of solving problems	3	0	3
Solution of linear equations	3	0	3
Graphing linear and sets of equations	3	0	3
Graphing quadratic equations	1	0	1
Graphing three dimensional	1	0	1
Fundamental operations with polynomials	1	0	1
Factoring algebraic expressions	1	0	1
Operation with logarithms	1	0	1
Geometric Skills and Concepts			
Properties of a circle	5	5	10
Properties of a right triangle	5	3	8
Definition of geometric terms: line, plane, parallel lines, angles, circle, etc.	5	1	6
Equivalence, similarity, and congruency	4	1	5
Intuitive, deductive, and inductive reasoning	3	0	3
Properties of a general triangle	2	1	3
Properties of a parallelogram	1	1	2
Elementary theorems of relationships of geometry	2	0	2
Non-Euclidean geometry	2	0	2
Axioms and postulates	2	0	2
Trigonometric Skills and Concepts			
Tangent ratio and tables	2	1	3
Operations with three functions	1	0	1

Items Treated in Required General College Mathematics Courses — Seven of the institutions included in this study — five white and two negro — required of all of their students a content mathematics course which was a part of their general education program. Since the majority of the instructors listed the principal objective of these courses to be the development of proficiency in the mathematical concepts and skills considered of value to all students, the courses have been classified as general college mathematics.

Practically every instructor of general college mathematics who was interviewed emphasized that his students varied so much in mathematical ability and previous preparation that he had to reorganize his course every semester. The skills and concepts treated in any particular course varied from class to class under the same instructor.

The concepts and skills treated in the general college mathematics courses are listed in Table XVI. The same classification that was used in Arithmetic for Teachers is employed here with the exception that concepts and skills in mathematics of finance and statistics are added to this list.

The same care and system were used in the determination of the items treated as were used in the selection of the items for Arithmetic for Teachers. It will be observed from Table XVI that there are fifty-five items which were treated in general college mathematics courses. Twenty-nine or 53 per cent of the items were common to at

least half of the courses. The Arithmetic for Teachers and the general college mathematics have approximately the same variability in topics. In general, the major emphasis on Arithmetic for Teachers was on the concepts and skills of arithmetic, while the general college mathematics courses most frequently treated concepts and skills of algebra and geometry. The typical general college mathematics course contained a digest of high school algebra and an introduction to geometry. As in most high school courses of study, little attention was given to computational skills in arithmetic in the general college mathematics courses. There was also a definite lack of attention on the use of multi-sensory aids in these courses.

A comparison of the content of the general college mathematics and the Arithmetic for Teachers courses (Tables XV and XVI) reveals only six concepts and skills which received the attention of the majority of the instructors in both of the classifications. These six concepts and skills were: (1) development of decimal number system, (2) manipulation of algebraic equations, (3) rules of operation with positive and negative numbers, (4) properties of a right triangle, (5) ratio and proportions, and (6) methods of computing square root.

TABLE XVI

Items Treated in Required General College Mathematics Courses

Concepts and Skills	Frequency White	Negro	Total
Concepts Dealing with Systems of Numeration			
Symbolic expressions including common formulas	5	2	7
Scientific notation	3	2	5
Development of number system	3	2	5
Short history of mathematics	1	1	2
Nature and use of mathematics	1	0	1
Computational Skills in Arithmetic			
Computation with approximate numbers	3	2	5
Ratio and proportion	4	2	5
Square root	2	2	4
Percentage applications	1	2	3
Early methods of computation	2	1	3
Fundamental operations with integers, fractions, and decimals	2	1	3
Symbols of operation	1	1	2
Operation with denominate numbers	0	1	1
Manipulation and Uses of Multi-sensory Aids			
Napier's Bones	1	1	2
Scale drawing	1	0	1
Abacus	1	0	1
Concepts and Skills in Measurement			
Angles (degrees, radians, and mils)	3	1	4
Metric system	2	1	3
Development of measurement of time and location	1	1	2
Absolute and Relative Error	1	0	1
Algebraic Skills and Concepts			
Introduction to algebra	5	2	7
Solution of linear equations	5	2	7
Functional relationship	5	2	7
Laws of exponents	5	2	7
Rules of operation with positive and negative numbers	4	2	6
Manipulation of algebraic equations	4	2	6
Solutions of sets of equations	4	2	6
Solution of quadratic equations	4	2	6
Graphing of functions	4	1	5
Logarithms	2	2	4
Radicals	1	0	1
Progressions	1	0	1

TABLE XVI (Continued)

Concepts and Skills	Frequency		
	White	Negro	Total
Geometric Skills and Concepts			
Properties of right triangle	5	2	7
Surfaces, areas, and volumes	4	1	5
Inductive and deductive reasoning	3	1	4
Introduction to geometry	3	1	4
Similar figures	3	1	4
Euclid's elements	2	1	3
Simple tools of geometry	2	1	3
Five regular solids	1	1	2
Trigonometric Skills and Concepts			
Introduction to trigonometry	4	2	6
Operation with three trigonometric functions	4	2	6
Law of sines, cosines, and tangents	2	2	4
Vectors	1	1	2
Concepts and Skills in Mathematics of Finance			
Introduction to mathematics of finance	2	2	4
Interest (simple and compound)	2	2	4
Installment buying	2	2	4
Stocks and bonds	2	2	4
Annuities	2	1	3
Function of money	1	2	3
Insurance	1	1	2
Concepts and Skills in Statistics			
Frequency curve	1	1	2
Average, median, and mode	1	1	2
Standard deviation	1	1	2
Series	1	0	1

Summary of Other Types of Required Content Mathematics Courses -- Thirteen of the institutions studied required all prospective elementary teachers to complete courses in mathematics which were not designed primarily for elementary education majors. Seven of these institutions required courses which conformed to the traditional college mathematics sequence for mathematics majors -- two required a course in college algebra and a course in trigonometry, two required only a course in algebra, and three required a course in the mathematics of finance. Six of the institutions required mathematics courses which consisted primarily of pre-college mathematics courses -- one required a course in applied mathematics on the high school level and five required a course in which grade arithmetic books and grade workbooks were used as the basal material. These courses are listed in Table VII and the basal textbooks are listed in Table XIV. The courses are identified by their names, basal textbooks and materials. The concepts and skills are not listed for these courses.

The classification of content mathematics which has been listed as such did not complete the content mathematical education of the elementary majors. Many of the students had contact with content mathematics under at least three other circumstances. First, many of the instructors of methods of teaching arithmetic courses were dissatisfied with the mathematical preparation of their students. In five instances the students in these courses were required to complete no-credit work to correct revealed difficulties. In three other institutions, the students were encouraged to take diagnostic tests and through the use of

"self-help" devices improve their concepts and skills in the fundamentals of arithmetic. In each of the eight instances the materials for study were selected from arithmetic workbooks.

Second, forty-two of the fifty institutions studied offered some work in the methods of teaching arithmetic. It is almost impossible and not desirable to conduct a course in the methods of teaching arithmetic without bringing in content materials. It was originally planned in this study to divide the methods courses on the basis of the time spent on content and time spent on methods of presentation. The two are so closely interwoven that any basis of division is impractical. The importance of content mathematics in methods courses is further emphasized upon examination of the basal textbooks used in these courses (Table XVII). A list of the items treated in the methods courses are presented on pages 98 and 103.

Third, many of the students were brought into contact with content mathematics in their intern teaching. In some institutions, the experience which the students had in their intern teaching with contact mathematics were their most important contacts. A few of the intern teaching programs were conducted in centers away from the college campus. In the majority of cases intern teachers were under the supervision of college staffs and the public school teachers and supervisors. Many additional contacts would have been necessary in order to analyze the mathematical experiences in intern teaching. Time and facilities available did not permit the inclusion of that phase of the work into this study.

Analysis of the Required Methods of Teaching Arithmetic Courses

It was pointed out in the discussion dealing with content mathematics that 34 per cent of the institutions studied did not require any content mathematics courses of their elementary education majors. The students' ability to understand the fundamental skills and concepts of arithmetic has been questioned by many authorities. Writers in the field of methods of teaching arithmetic contend that even if they had an adequate working knowledge of the processes of arithmetic, they would still need additional arithmetic education in order to serve effectively as a teacher.

Taylor and Mills listed some of the material that should be presented in this additional arithmetic education.

> The first task in preparing these students to teach arithmetic is to give them not a review but a new view of the subject -- a teacher's view that insures a mastery of the processes and a clear perception of their difficulties of explanation; that unifies the subject matter, making clear the aims of arithmetic and the proper choice of materials to obtain them; and that by historical references give some knowledge of the development of arithmetic and its place in human culture.[2]

The art of computation is not enough. The teacher must be adept and well equipped to answer questions relating to the science of numbers.

Roantree and Taylor briefly outline some of the additional concepts and skills which should be included in every teacher's education.

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[2] E. H. Taylor and C. N. Mills, Arithmetic for Teacher-Training Classes (New York: Henry Holt and Co.), 1949, p. iii.

> The teacher should know something of the historical development of mathematics, for this acquaints him with the stages of mathematical progress. He should understand the logical development of the subject, for this leads to an appreciation of the value of sequence, to the recognition of various types of experiences, and to an understanding of the methodology of subject matter. He should understand something of the utility of the subject — 'the human significance of mathematics'; this gives him a zeal for his subject, an assurance in the value of what he presents, and a guide for the formation of good habits in the use of mathematical tools.[3]

The following discussion deals with the additional mathematical education given prospective elementary teachers in the methods of teaching arithmetic.

Basal Textbooks Used in Methods of Teaching Arithmetic — It was noted in the discussion on content mathematics that time was spent on mathematical content in the methods of teaching arithmetic courses. The reader who is familiar with the titles listed in Table XVII can readily draw his own conclusions as to the emphasis that the author put upon content mathematics. This point is further emphasized in the analysis of the content of the methods courses.

Sixteen of the twenty-one courses which were special courses in the methods of teaching arithmetic were under the supervision of the education departments. The other five courses were under the supervision of the mathematics departments. All of the courses dealing with general methods were under the supervision of the education departments.

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[3] W. E. Roantree and M. S. Taylor, An Arithmetic for Teachers (New York: The Macmillan Co.), 1932, p. vi.

TABLE XVII

Basal Textbooks Selected for Methods of Teaching Arithmetic

Author	Textbook	Frequency White	Negro	Total
	Special Courses			
Brueckner and Grossnickle	How to Make Arithmetic Meaningful	6	1	6
Spitzer	The Teaching of Arithmetic	3	2	5
Morton	Teaching Arithmetic in the Elementary School, Primary Grade	4	0	4
Taylor and Mills	Arithmetic for Teacher-Training Classes	1	2	3
Clark et al.	First Steps in Teaching Numbers	1	0	1
No Basal Text		1	0	1
	General Courses			
Lee and Lee	The Child and His Curriculum	3	0	3
Spitzer	The Teaching of Arithmetic	2	0	2
Saucier	Theory and Practice in the Elementary School	0	1	1
Hildreth	Learning the Three R's	0	1	1
Brueckner and Grossnickle	How to Make Arithmetic Meaningful	1	0	1
North Carolina Series of Grade Books		1	0	1
Tenth and Sixteenth Yearbooks, National Council of Teachers of Mathematics		1	0	1
No Basal Text		10	1	11

There were five basal textbooks selected by the twenty-one institutions that required a special course in the methods of teaching arithmetic. Two of the institutions required two textbooks. One used Morton's Teaching Arithmetic in the Elementary School, Intermediate Grade and Brueckner and Grossnickle's How to Make Arithmetic Meaningful. The other combined Spitzer's The Teaching of Arithmetic and Morton's Teaching Arithmetic in the Elementary School, Primary Grade. Of the remaining eighteen institutions that selected one basal text, five selected Brueckner and Grossnickle's How to Make Arithmetic Meaningful, four selected Spitzer's The Teaching of Arithmetic, three selected Morton's Teaching Arithmetic in the Elementary School, Primary Grade, three selected Taylor and Mill's Arithmetic for Teacher-Training Classes, two selected Morton's Teaching Arithmetic in the Elementary School, Intermediate Grades, and one selected Clark, Otis, and Hatten's First Steps in Teaching Numbers.

The one instructor who had not selected a basal text used a collection of material. This collection consisted of a small library of books. The instructor had formerly held positions as state superintendent, county superintendent, principal, and supervisor. Through the years he gathered a collection of books and other teaching materials. The collection consisted of hundreds of the grade textbooks in arithmetic, histories of mathematics, pure mathematics texts, courses of studies mathematical magazines, yearbooks, films, slides, and multiple copies of the texts written on methods of teaching arithmetic. The students were encouraged to spend an hour a day browsing through the material. The

writer spent an hour reading titles.

Five of the twenty-one institutions that taught methods of teaching arithmetic as a part of a general methods course used as their basal material sections of a general methods textbook. Three used Chapter X of Lee and Lee's The Child and His Curriculum, one used Chapter X of Saucier's Theory and Practice in the Elementary School, and one taught from Chapters XXIII and XXVIII, inclusive, of Hildreth's Learning the Three R's. One institution used the North Carolina Series of Grade Books while another institution used the Tenth and Sixteenth Yearbooks of the National Council of Teachers of Mathematics. The schools that had not selected a basal text used source material from their libraries and personal collections.

All of the institutions studied, that included Methods of Teaching arithmetic in their curriculums, provided a wealth of reference material for the courses. In every case the instructors indicated that the students had available a selection of texts on the methods of teaching arithmetic, a wide selection of arithmetic grade books and workbooks, educational journals, and yearbooks. Many of the instructors indicated that they had taken advantage of the publishers' offers to supply this material for their methods course. The writer visited many of the libraries and examined the reference material. At least five of the instructors had converted their classrooms into a typical grade-school room. Their reference material was shelved in these rooms. The walls were decorated with pictures, charts, graphs, flash cards, systems of notation, and so forth. The instructors in these rooms alternated

their material as they studied different subjects. Four of the institutions had provided separate libraries for their elementary teachers. In the majority of cases the textbooks, magazines, yearbooks, films and slides were shelved in the main libraries. The instructors supplemented this material in the libraries with personal collections of texts, workbooks, and multi-sensory aids.

Analysis of the Content in Special Methods Courses -- The selection of the items which were presented and developed in the methods of teaching arithmetic was considered one of the important phases of this study. A considerable portion of the time spent in interview with the instructors was devoted to the isolation of these items.

In a few of the cases the instructors had previously prepared syllabi. These were checked for additions and deletions. In a majority of the cases the instructors gave an oral description of the content of their courses. Their recall was aided by the use of the prepared checklist and pointed questions, such as "What do you spend your time doing?" "What materials do you use in the classroom?" "What materials or resources outside classroom do you use?" and so forth. In a few cases where the syllabi did not seem complete to the interviewer, an effort was made to have the instructors assign the amount of time which had been devoted to the listed items. This served as a check on the completeness of the information received in regard to the programs. In the cases where the instructors designated chapters and sections of textbooks as their syllabi, the interviewer leafed through the texts with the instructors and checked the deletions. In many cases sup-

plementary and related items were recalled by the instructors through the use of this method. It is believed by the writer that the items listed in Table XVIII are a fairly accurate representation of the content of the special methods courses. This statement is based upon a knowledge of the great care that was taken in the selection and classification of the material and the willing cooperation of the interviewed instructors. Staff members expressed more interest in the results of this section than of any other. Many asked for a summary of these results in order that they could compare their syllabi with the presentation of the group.

Table XVIII lists the items that were presented and developed in the special courses in the methods of teaching arithmetic. Only those items that had a frequency of five or more are included in the table. The items are listed in three categories, namely (1) topics treated, which include general method procedures as well as methods of developing arithmetical skills and concepts, (2) materials used in the classroom, and (3) materials and resources used outside classroom. The items are checked for each of the fifteen white and six negro institutions that offered the course. The items which were included by institutions but which had a frequency of less than five are listed at the bottom of Table XVIII. Four items were listed by two instructors and fourteen items were listed by one instructor only. The letters which designate the institutions that included the items are enclosed in parentheses.

TABLE XVIII

Analysis of the Special Methods Courses of Teaching of Arithmetic

Twenty-one Institutions	White															Negro						Frequency		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U			
Semester Hours	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3	3	2	2	White	Negro	Total
Items Treated																								
Methods of presentation of four fundamental operations with:																								
Integers	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	15	6	21
Fractions and decimals	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	13	6	19
Aims and objectives of arithmetic	x	x	x	x		x		x	x	x	x	x	x	x	x	x	x	x		x	x	13	5	18
Methods of improving problem solving	x	x	x	x	x	x		x	x	x		x	x	x	x	x	x	x	x	x	x	12	6	18
Means of developing number concepts	x		x	x	x	x	x	x	x	x	x	x	x		x		x	x		x	x	13	4	17
History and dev. of number system	x				x	x		x	x	x	x	x	x	x	x			x	x	x	x	11-	5	16
Methods of presenting percentage	x	x	x		x	x		x	x			x	x	x		x	x	x	x	x	x	10	6	16
Testing in Arithmetic	x	x	x				x	x	x	x		x	x	x	x	x	x		x		x	11	4	15
Evaluation of grade textbooks		x	x	x	x			x		x		x	x	x	x		x		x	x	x	10	4	14
History and methods of presenting weights and measures	x		x	x	x			x	x	x		x	x	x		x	x		x		x	10	4	14
Arithmetic readiness and grade place		x	x	x				x	x	x		x	x	x	x		x		x		x	10	3	13
Evaluation of pupils work	x		x	x				x	x	x		x	x	x	x		x			x	x	10	3	13
Providing for individual differences	x	x		x				x	x	x	x	x	x	x	x						x	11	1	12
Theories of learning	x	x		x		x		x				x	x			x	x	x	x		x	7	5	12
Evaluation of workbooks	x	x	x	x	x		x	x		x		x	x		x		x					11	1	12
Surveys of curriculums and courses of studies	x	x		x				x	x	x		x	x				x		x		x	8	3	11
Causes of failure in arithmetic	x	x		x		x		x	x				x	x			x		x		x	8	3	11
Diagnostic and remedial procedures	x	x		x				x	x				x	x			x				x	8	2	10
Development of instructional units	x			x					x		x		x	x			x			x		7	2	9
Development of lesson plans							x			x			x	x			x		x	x	x	4	4	8

TABLE XVIII (Continued)

Twenty-one Institutions	White													Negro					Frequency		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	White	Negro	Total
Semester Hours	3	3	3	3	3	3	3	3	3	3	3	2	2	2	2	3	3	3	3	2	2			
Development of arith. vocabulary	x		x				x	x			x	x				x				x		6	2	8
Presentation of recreational math.						x	x		x		x		x			x		x		x		5	3	8
Evaluation of supplementary devices	x		x			x			x		x			x		x	x					6	1	7
Procedures in supervised study	x	x					x				x	x								x		5	1	6
Materials Used in Classroom																								
Books and references	x		x			x	x		x	x	x	x	x	x		x		x	x			10	3	13
Instruments of measure			x	x	x	x			x		x	x	x	x				x	x	x		9	3	12
Construction equipment	x	x				x			x	x	x	x	x	x					x			8	1	9
Motion pictures and slides	x		x		x		x	x					x	x		x						7	1	8
Illustrations and pictures	x		x		x	x					x	x								x		6	1	7
Business forms and exhibits					x	x		x			x	x										5	0	5
Materials or Resources Outside Classroom																								
Observation of Classroom work			x		x		x	x			x	x						x				6	1	7
Participation in school and community mathematics activities	x				x						x	x		x								5	0	5
Excursions and field trips			x					x			x	x		x								5	0	5

The following items were included by fewer than five of the institutions. The letters which designate the institutions that included the items are in parentheses. Development of methods of finding square root and applications of Pythagorean theorem (E,K); Introduction to Mathematics of Finance (E,R); Presentation of Abacus (E,O); Presentation of term report (D); Meaning of concepts and skill processes to children (D); Dramatization (D); Presentation of factors and multiples, computation with approximate numbers, areas and volumes, ratio and proportion, longitude and time, metric system of measurement, and selection of learning experiences (E); Flash cards and flannel graphs (G); Development of fundamental formulas (K); Reports to use in practice teaching (M); Development of social phases of arithmetic (O).

The frequency with which each item was reported is indicated by the number of checks in the corresponding row in Table XVIII. The content of the courses for each particular school is indicated by the checks in the corresponding column. For example, all of the twenty-one instructors discussed methods of presenting the four fundamental operations with integers; thirteen — ten of the fifteen white instructors and three of the negro instructors — stated that they brought supplementary books and other types of reference materials into their classrooms; seven — six white and one negro — stated that their students were required to observe classroom teaching in the elementary schools. In order to determine the complete list of items reported by any one instructor, it is necessary to check the items at the left of the x's in any one column under the capital letters and to check the letters in the parentheses at the end of the table to pick up those items that had a frequency of less than five. For example, the instructor at institution (G) reported nine items which are listed opposite the x's checked under (G) plus flash cards and flannel graphs which are in the list at the end of the table.

It will be observed from Table XVIII that there are thirty-three items listed with a frequency of five or more. Seventeen of these items are common to at least half of the required special methods courses. It is interesting to note that methods of presentation of the four fundamental operations with integers is the only one that was common to all of the courses.

The minimum number of items that was developed in any one course

was eight in institution (P). The instructor of this course confined his work to the presentation of items without introducing any materials or utilizing any outside resources. The maximum number of items included in any one course was thirty-one in institution (M). The average for the twenty-one institutions was 14.6 items treated, 2.6 types of materials utilized in the classroom, and .8 utilization of outside materials or resources. Three reported that they did not present any supplementary material to their classes and ten reported that they did not utilize any outside materials or resources. The great differences between the number of items became apparent to the interviewer early in the survey. An effort was made to determine the reason for this variation. The only satisfactory explanation given was that the instructors who developed only a few items spent their time in the development of the fundamental concepts and skills of content mathematics. Only two instructors of methods of teaching arithmetic indicated that they thought that it was not their responsibility to clarify any mathematical weaknesses displayed by their students.

Analysis of the Content in General Methods Courses — The same care and procedure were taken in the selection of the items included in the general methods courses as were taken in the analysis of the special methods courses in the teaching of arithmetic. The items dealing with the methods of teaching arithmetic were very diversified. There were forty-three items included by the twenty-one instructors that reported on their general methods courses. The ones that had a frequency of three or more are included in Table XIX. The items that

had a frequency of three or more are included in Table XIX. The items that had a frequency of one or two are listed on page 104. The letters that designate the institutions that included the items are enclosed in parentheses.

There is only one item -- presentation of aims and objectives of arithmetic -- that is common to at least half of the courses. Approximately one-third of the instructors included the following: methods of computation with integers, fractions, and decimals; improvement of problem solving; methods of presenting percentage; and theories of learning. The balance of the items were included by five or fewer of the instructors. Four of the instructors reported just one item or activity each. Institution (A) reported that three semester hours were devoted to individual projects designed to meet the needs of the prospective teachers. The needs of each student were determined by extensive student-teacher conferences. The remedial work included refresher work in content mathematics as well as instruction in the methods of presentation. Institution (C) included a review of the state adopted textbooks. Institution (K) spent all of the time allocated to the methods of teaching arithmetic -- three-tenths of a semester hours -- in observation of elementary teachers teaching arithmetic. The instructor at (R) reported that her methods of teaching arithmetic consisted of requiring all girls "to sell concessions and keep a record of the transactions."

TABLE XIX

Analysis of Methods of Teaching Arithmetic Included in General Methods Courses

Twenty-one Institutions	White																Negro			Frequency		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	White	Negro	Total
Semester hours	3	1	1	.9	.8	.7	.5	.5	.3	.3	.3	.3	.3	.2	.2	.2	.2	.0	1	.5	.2			
Items Treated																								
Aims and objectives of arithmetic				x	x	x		x	x		x			x		x	x		x	x	x	8	3	11
Methods of presentation of:																								
Computation with integers	x				x	x	x		x					x					x			7	1	8
Computation with fractions	x			x	x	x	x		x					x					x			7	1	8
Improving problem solving	x					x	x	x						x	x	x			x			7	1	8
Theories of learning			x			x	x	x			x					x	x			x		7	1	8
Methods of presenting decimals	x				x	x	x		x					x					x			6	1	7
Methods of presenting percentage	x				x	x	x		x					x					x			6	1	7
Evaluation of textbooks				x	x	x	x	x			x			x								7	0	7
History and development of our number system	x		x	x							x			x								5	0	5
Diagnostic and remedial methods						x		x							x	x						4	0	4
General presentation procedures			x	x				x								x						4	0	4
Causes of failure						x	x				x								x			3	1	4
Evaluation of workbooks and material					x	x		x						x								4	0	4
Evaluation of pupils' work				x	x	x															x	3	1	4
Development of instructional units						x										x			x			2	1	3
Development of lesson plans						x										x			x			2	1	3
Testing in arithmetic						x	x							x								3	0	3
Development of number concepts				x	x		x															3	0	3
Review of adopted state texts		x										x							x			2	1	3

TABLE XIX (Continued)

Twenty-one Institutions	White																	Negro			Frequency		
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	White	Negro	Total
Semester hours	3	1	1	9	8	7	5	5	3	3	3	3	3	2	2	2	2	0	1	5	2			
Materials Used in Classroom																								
Free and inexpensive materials				x	x								x						x	x		3	2	5
Construction equipment							x	x	x			x										4	0	4
Motion pictures and slides						x	x		x													3	0	3
Activities Outside Classroom																								
Observation of Classroom Work						x		x			x									x		3	1	4

Items dealing with the methods of teaching of arithmetic that had a frequency of two or less are listed with the letter of the institution that included them in parentheses: Study state courses of study (G,T); Individual differences (E, G); Development of activities to include subject matter (I, P); Presentation of instruments of measure (G, H); Individual projects to care for the individual differences and needs of the college students (A); Presentation of weights and measures (G); Methods to improve arithmetic vocabulary (G); Developments of techniques in supervised study (S); Presentation of term reports (D); Recreational mathematics (G); Presentation of manipulation with denominate numbers (B); Presentation of graphs (B); Presentation of number system with a base different than ten (E); Explanation of place value (E); Discussion of individual problems of the student (E); Selection of multi-sensory aids (P); How to make a functional program (Q); Review of research in the teaching of arithmetic (U); Presentation of the abacus (E); Buying and selling concessions and keeping a record of the transactions (R).

Education and Elementary School Experience of Teachers of Special Methods Courses — An analysis was made of the education, in terms of academic degrees, and the elementary school experience of the twenty-one staff members who were teaching the special methods courses in arithmetic. This information is recorded in Table XX. The former positions of some of the staff members included many different types of experiences with the elementary schools. For example, one professor had taught in the elementary schools and had held the positions of principal, superintendent, county supervisor, state superintendent, professor of education, and professor of adult education. In Table XX only one position is checked for each individual and that position has been checked from the following ordered list: (1) elementary teacher, (2) principal elementary school, (3) county supervisor, and (4) county or city superintendent.

Table XX reveals that ten of the fifteen white instructors had doctor's degrees — eight in education and two in mathematics. Five of the white instructors had a master's degree in education. The six negro instructors had their master's degrees — three in education and three in mathematics. All but three of the twenty-one instructors had held positions connected with the elementary schools. Twelve had taught in the elementary schools, two that had not taught had served as principals, and four of the remaining seven had held positions as supervisor or superintendent. Only three had not had any experience in the elementary schools before entering college work.

TABLE XX

Degrees and Elementary Experience of Instructors of Methods of Teaching Arithmetic

Experience	Degrees			
	Doctor's Education	Doctor's Math.	Master's Education	Master's Math.
Elementary Teacher	w-4 n-0	w-0 n-0	w-3 n-3	w-0 n-2
Principal of Elementary School	w-1 n-0	w-0 n-0	w-0 n-0	w-0 n-1
County Supervisor	w-0 n-0	w-0 n-0	w-2 n-0	w-0 n-0
Superintendent	w-2 n-0	w-0 n-0	w-0 n-0	w-0 n-0
No Elementary Experience	w-1 n-0	w-2 n-0	w-0 n-0	w-0 n-0

Other Aspects of Programs for Education of Elementary Arithmetic Teachers

Selection of Elementary Education Majors — In the institutions included in this study, the students who desired entry into the elementary teacher education programs were not required to pass selective requirements for admission into these programs. The only requirements designated to screen students were the general college entrance requirements. In every case any student who could meet the college or university entrance requirements could enroll in the program that was designated to educate prospective elementary teachers. This is not to be construed to mean that everyone could complete the requirements or that

the colleges were required to continue to enroll the students that were judged as undesirable candidates. As one dean reported, "We have to take them; we don't have to keep them."

Forty-nine of the fifty institutions required that an advisor of the elementary education department approve all of the programs of his prospective elementary teachers. The instructors indicated that this was a very effective device to screen the undesirables; however, many of them pointed out that their advisory systems did not prohibit students from meeting state requirements and securing certificates in those states that did not require a degree or recommendation by a college.

In-Service Education of Teachers — In the narrow sense teacher education is thought of as including the experiences encountered by students in their preparation to qualify as teachers. Karl Bigelow defines teacher education as ". . . a continuous process whereby individuals grow steadily in their ability to serve the best interests of society and to help boys and girls satisfy their personal-social needs."[4]

The Commission on Teacher Education, which was sponsored by the American Council on Education conducted a study of public school systems in 1946. The entire study was focused on both group and individual actions designed to result in increased teaching competence. The

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[4] The Improvement of Teacher Education, a final report by Commission on Teacher Education (Washington, D. C., American Council on Education), p. 120.

Commission believed that ". . . the kind of general in-service growth that it saw as needful especially required leadership and activity where the teachers were regularly employed — in the school systems themselves."[5] The need of the services of the colleges and universities in providing educational opportunities for teachers in-service was recognized by the Commission but only the in-service education that originated in the local schools was included in their study.

An attempt was made in this study to determine the services rendered by the institutions to in-service arithmetic teachers. All but seven of the institutions studied indicated that they had participated in some in-service education of elementary arithmetic teachers during the school year of 1949-50.

Of the enormous number of classes organized in extension,[6] correspondence, Saturday, and evening classes, only one institution reported an extension class in the Teaching of Arithmetic. One institution taught an evening class in content Arithmetic for Teachers, and another offered an elective course during the summer session which dealt with methods of teaching arithmetic. This was in addition to the regularly scheduled methods courses which were required of all elementary education majors. Many of the mathematics classes taught were not recorded in this study, because they were not designed for

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[5] Ibid., p. 120.

[6] One institution indicated that they had enrolled more than 3,000 students in extension in 1949-50.

elementary teachers. This does not imply that elementary teachers were not enrolled in those courses. The instructors interviewed had no record of the number of elementary teachers completing correspondence courses.

Twenty-seven of the instructors interviewed reported that they served as consultants and advisors to teachers of arithmetic, two had given lectures on the teaching of arithmetic, and four had participated in institute sessions that were concerned with problems of arithmetic in the elementary school. Six instructors indicated that they had attended group in-service meetings dealing with arithmetic problems and procedures. One instructor reported that he had conducted a county-wide testing program in arithmetic, and another reported participation in a county-wide planning program. Three of the fifty institutions conducted workshops during the summer of 1950 that dealt all or in part with arithmetic in the elementary schools.

Follow-up of Graduates — One of the assumptions of this study was that constant evaluations were important aspects of any teacher education program. One procedure for making such an evaluation involves the appraisal of the teaching success of the graduates. An effort was made to determine what follow-up work was being done in the institutions included in this study. The study revealed that this phase of the teacher education program was probably the most neglected of all and was practically non-existent in many of the institutions. At least half of the interviewed instructors and directors of elementary

education programs indicated that they planned to organize a system to evaluate their grades but had not gotten around to it. Not one individual questioned the desirability of such a practice.

One university has worked on a measuring instrument which is to be released in the near future. For years this university has checked on its graduates by having the employing school officials fill in this check-sheet. Eleven of the institutions reported that they checked on a few of their graduates through personal visitations and correspondence. Four indicated that their number of elementary graduates was so small that they were able to keep check on all graduates through personal contacts. One reported that a systematic check was made of all graduates that received positions in the home city and another reported a similar check on all students employed in their local county. One reported that the Public Relations Officer kept a record of the graduates but the interviewer was unable in this case to determine if any evaluation was made of the teachers. Three institutions reported that they received principals' reports on their graduates from the county superintendent's office. Twenty-eight of the fifty institutions indicated that they made no attempt to check on the teaching abilities of their elementary graduates.

Instructors' Comments on Existing Programs — At the close of the interview, the instructors were encouraged to comment on the effectiveness of their programs and to offer constructive suggestions. The question was asked, "Are you satisfied with the program which you have for the education of elementary arithmetic teachers?" If the answer

was "yes" the discussion was not pursued any further by the interviewer. Therefore, many instructors did not elaborate or give reasons why they were satisfied. It was assumed by the commentators and the interviewer that the programs indicated the basis for their judgments. However, if the instructors indicated that they were not satisfied with their programs, they were encouraged to offer suggestions which they thought would improve the programs.

The comments which were pertinent to this study have been classified and summarized by the writer. Since many of the comments are on particular programs, the required hours in content mathematics and required hours in methods of teaching arithmetic are listed in the order named, semester hours preceding the comment. The abbreviations En. or Ms. following the numbers designate the department in which the commentator was employed. For example, (3, 1, Ms.) indicates that the comment was given by an instructor employed in the mathematics department of an institution that required three hours of content mathematics and one hour of methods of teaching arithmetic.

Twenty-six instructors that were interviewed commented favorably on twenty-two of the programs included in this study. The twenty-two programs that were rated satisfactory by the instructors required an average of 2.8 semester hours of content mathematics and an average of 1.2 semester hours of methods of teaching arithmetic.

A few of the comments that accompanied the affirmative replies are:

(0, 1.7, En.) There is nothing the matter with our program as

we have it functioning now. Results of progressive achievement tests for county pupils show that the pupils are higher in arithmetic reasoning and arithmetic fundamentals than they are in other school subjects.

(3.3, 2, En.) Our program works very nicely when the basic course in arithmetic is taught before the methods.

(6, 0, Ms.) The girls are given a satisfactory course in the mastery of the basic fundamentals and are given a connected idea of the subject matter of arithmetic with particular emphasis on its nature, significance, and use. An attempt is made to give the girls an enriched background of mathematical experiences.

(0, 1, En.) Girls are adequately prepared. Enough time is spent on arithmetic -- more than is necessary.

Six of the instructors were dissatisfied with their programs because of the type of content mathematics offered or required. Two of these instructors indicated that they refused to recommend that their elementary majors take any mathematics content courses offered by the mathematics departments. Some of these comments indicate a lack of cooperation between mathematics departments and departments of education. The following comments are typical of this group:

(2, 2, En.) Our students need the actual learning of meaning behind numbers, meaning of numbers, foundation of four fundamental operations, paper and memory work in arithmetic, good background in solving problems. The mathematics they are getting is not satisfactory. /Two hours of content mathematics required was general college mathematics./

(2, .2, Ms.) We in the mathematics department would be happier if the so-called applied mathematics course were a no-credit course required of those who show a need and we were free to teach a course which would be a good foundation for our college work. /Two hours of content mathematics was applied high school mathematics./

(0, 1.7, En.) The mathematics department does not offer a single course that would be any help whatsoever to any

elementary teacher. We discourage them from taking any mathematics listed as such.

(6.7, .3, En.) Very little time is spent on arithmetic. We have too many other things to do. The students do have a good background in mathematics but not of the right kind.

The programs were most frequently criticised for the lack of time devoted to mathematics. Some education instructors indicated that they did not have sufficient time to teach the methods of teaching arithmetic. Other instructors suggested the need of additional mathematics courses. The following comments are typical of these two groups:

(0, 3, En.) All of our students need more basic mathematics. We do not have enough time on a two year program.

(3, 0, Ms.) The students need a general course in arithmetic. This should be followed by algebra and elementary geometry -- survey of plane and solid. They should understand the history of mathematics. Six hours of content mathematics would be a minimum.

(3.3, .3, Ms.) We are unable to find time to teach both content and methods and we consider content more important than methods.

(4, .8, En.) The methods of teaching arithmetic should be handled by the mathematics department. The need is important; however, reading and language are neglected by my department and should have all of the time allotted to methods.

Summary

1. Approximately three-fifths of the four-year institutions included in this study admitted high school graduates without prescribing a definite pattern of prerequisite high school courses. The average number of prerequisite mathematics units required by the twenty-one

institutions that did set up a pattern for admission was 1.8 units.

2. Approximately one-half of the white institutions and all of the negro institutions that were included in this study required some content mathematics of their elementary education majors. The hour requirements in content mathematics in every institution were equal to or greater than the local state certification requirements. Only 13 per cent of the total hours of content mathematics required by the institutions was specified by state certification regulations. The average requirement of the twenty-one white institutions that specified content mathematics was 3.3 semester hours; the average for the twelve negro institutions was 4.3 semester hours.

3. There was a tendency for the institutions included in this study to require all elementary education majors to take the prescribed content mathematics courses regardless of the individuals' proficiency or background in mathematics. Only four of the institutions used mathematics exemption examinations. There was a great variation in the complexity of the mathematical concepts and skills covered by the different tests that were used.

4. Committees selected from elementary and general education faculties were responsible for the selection of four-fifths of required content mathematics in the institutions included in this study. These committees did not agree on the type of content mathematics that should be required. Approximately one-half of the content mathematics courses that were required of elementary education majors in the institutions included in this study were planned primarily for prospective

elementary teachers. There was a tendency to require courses that already existed in the mathematics departments. The content mathematics courses required included Arithmetic for Teachers, general college mathematics, grade arithmetic, algebra, mathematics of finance, trigonometry, and applied high school mathematics.

5. There was also considerable disagreement even among the instructors of the course, Arithmetic for Teachers, as to the content. Approximately one-half of the sixty-five concepts and skills were common to only one-half of the courses. The items most frequently agreed upon fell in concepts dealing with systems of numeration and computational skills in arithmetic.

6. Approximately four-fifths of the institutions included in this study required some work of their elementary education majors in the methods of teaching arithmetic. Twenty-one required a special course in the methods of teaching arithmetic and twenty-one included methods of teaching arithmetic in required general methods courses.

7. All of the institutions included in this study required some work in either content mathematics or methods of teaching mathematics of their elementary education majors. This required work varied from .2 to 9.0 semester hours with an average of 3.8 semester hours. Approximately one-half of the institutions that required a special course in the methods of teaching arithmetic also required a content course in mathematics.

8. There was no significant difference in the average amount of mathematics — content and methods — required by the different

types of white institutions. The averages for the universities, liberal arts colleges, and teachers colleges were 3.3, 3.1, and 3.3 semester hours, respectively. The number of cases of the negro institutions in any one type were too few to arrive at any conclusion in regard to the relation between mathematics requirements and types of institutions.

9. All but one of the four-year institutions included in this study offered a major in mathematics which included content mathematics courses at least through calculus. Elementary education majors, as a general rule, did not select any of these mathematics courses as electives. Counselors estimated that the number of elementary majors that selected content mathematics as electives varied from one out of ten to less than one in a hundred.

10. The fourteen institutions that required courses designated as Arithmetic for Teachers limited the selection of their basal textbooks to six different texts. There was little agreement in the selection of the texts for the remaining content courses required of elementary majors; twenty-one different basal texts or workbooks were selected as basal material for twenty-two courses.

11. The content mathematics in the institutions that had a general education program consisted primarily of a course in general college mathematics. There was a lack of agreement among the schools as to the topics included in general college mathematics courses. One-half of the fifty-five items treated were common to only one-half of the courses. The typical general college mathematics course contained

a digest of high school algebra and an introduction to geometry. Seventeen of the institutions that did not have a general college program required all elementary education majors to complete at least the traditional content course from the college sequence provided for mathematics majors or a course in pre-college mathematics.

12. There was a great variance among the institutions in the number of items selected for the methods of teaching arithmetic courses. There was agreement on seventeen of the items by the majority of the instructors in the special methods courses. Only one item — aims and objectives of arithmetic — was common to the majority of the general courses.

13. The works of Morton, Brueckner and Grossnickle, Taylor and Mills, and Spitzer were the most popular texts in the methods of teaching arithmetic. The texts have been listed in decreasing order of frequency of selection.

14. Ten of the instructors of the twenty-one special methods courses held doctor's degrees — eight in education and two in mathematics. Eighteen of the twenty-one instructors had had some experience in the elementary schools.

15. As a general rule, the students are not required to pass selective requirements for admission into the elementary education programs of the institutions included in this study. Upon meeting general entrance requirements, the students are free to choose the elementary education field. After making the choice of the elementary field, students in forty-nine of the fifty four-year institutions must

have their programs approved by staff members of the elementary education departments. In most institutions the programs were predetermined except for a few electives.

16. Staff members of forty-three of the fifty institutions reported that they had participated in some in-service education of elementary arithmetic teachers during 1949-50 school year. The majority of this participation consisted of consultant and advisory service, lectures, discussion at institutes, pre-school planning, and group discussions. Three arithmetic courses were organized by three different institutions for in-service elementary teachers. One instructor conducted a county-wide testing program which included arithmetic fundamentals and another instructor planned a county-wide arithmetic program.

17. Less than one-half of the programs that were analyzed were rated satisfactory by the instructors who were interviewed. The programs that were rated satisfactory required an average of 2.8 semester hours of content mathematics and 1.2 semester hours of methods of teaching arithmetic. These averages are .6 semester hours higher for content mathematics and .2 semester hours lower for the methods of teaching arithmetic than the averages for the fifty institutions included in this study.

18. The instructors indicated that they had done very little to determine the success of their graduates. They did not have available any data collected from follow-up work to serve as a check of the adequacy of their programs. One institution was in the process of developing a formal instrument to be used to check their graduates. Staff members of twenty-one of the fifty institutions reported that they had checked former students through personal contacts and correspondence.

CHAPTER VI

ANALYSIS OF THE PROGRAMS DESIGNED FOR THE PREPARATION OF ELEMENTARY ARITHMETIC TEACHERS IN JUNIOR COLLEGES IN THE SOUTHEAST

A study of the programs designed for the preparation of elementary arithmetic teachers in the Southeast would be incomplete if the participation of the junior colleges were omitted. There are ninety-five junior colleges — eighty-eight white and seven negro — located in the nine states included in this study. Fifty-six of these institutions are operated by religious organizations. Seventeen are private institutions; ten are under the supervision of the county or district in which they are located; eight are operated by state boards; and four are city owned and operated.

The questionnaire method was used in an attempt to secure information concerning their programs. A copy of the questionnaire, which was described on page 45, is included in Appendix C.

The purpose of this chapter is to present an analysis of the information furnished by the respondents to the questionnaire. The data are presented under the following headings:

1. Analysis of the number of junior college students included in the study
2. Hour requirements in content mathematics and methods of teaching arithmetic
    a. Admission requirements in mathematics
    b. Entrance examinations in mathematics and refresher courses in mathematics
    c. Hour requirements in content mathematics

d. Hour requirements in the methods of teaching arithmetic
e. Total hour requirements in content mathematics and methods of teaching arithmetic

3. Content mathematics courses required in junior colleges

a. Basal textbooks used in content mathematics courses
b. Classification of content mathematics courses

4. Basal Textbooks used in methods of teaching arithmetic courses

5. Instructors' comments on existing programs

6. Summary

Analysis of the Number of Junior College Students Included in the Study

A copy of the questionnaire was mailed to the head of the mathematics department of each of the ninety-five junior colleges located in the nine Southeastern states. It was understood at the time of mailing that Alabama, North Carolina, and Virginia required more than two years of education for their lowest certificates to teach in their elementary schools. However, colleges in these three states were included in an attempt to determine if they had established elementary education programs for the first two years of work. Thirty-four of the junior colleges were located in states that did not grant certificates on the basis of two years of college work. Fifty-nine questionnaires were returned. This represents approximately 62 per cent of the number mailed. Seventeen of the fifty-nine returned questionnaires were from junior colleges located in Alabama, North Carolina, and Virginia. Only two of these indicated that they had a planned program for elementary

teachers. This is not interpreted to mean that other junior colleges did not educate prospective elementary teachers for the first two years of their college work.

TABLE XXI

Analysis of the Number of Students Included in the Study

Classification	Number of Junior Col.	Enrollment*	Per Cent of Total
Total Junior Colleges in the Southeast	95	22,268	100
Number of Returned Questionnaires	59	14,368	65
Number Reported No Elementary Program**	29	7,048	32
Number Reported Complete Elementary Program	30	7,320	33

*Enrollments listed in the 1949-50 edition of the Education Directory Higher Education.

**Includes one junior college in Alabama and one in North Carolina that reported 3 and 15 students, respectively, working toward elementary certificates.

Four of the junior colleges reporting a program for the education of elementary teachers did not have available the number of graduates from their programs. The remaining twenty-six junior colleges reported 1,291 prospective elementary teachers graduated between June 15, 1949 and June 15, 1950. This number represents 29 per cent as many as were reported graduated from two-, three-, and four-year programs in the 156 four-year institutions in the nine states included in this study. This

relationship emphasizes the importance of the participation of the junior colleges in the education of elementary teachers. Figures are not available as to the number of these students that will teach during the school year of 1950-51. Some will continue their education in a four-year institution; nevertheless, they are qualified to teach so far as state certification requirements are concerned.

Hour Requirements in Content Mathematics and Methods of Teaching Arithmetic

Admission requirements in mathematics — Twenty-five of the junior colleges answered the question pertaining to prerequisites in mathematics for the elementary education programs. Eleven reported that there were no high school mathematics prerequisites for their programs. The prerequisites that were indicated are listed in Table XXII.

The total number of units of high school prerequisites in mathematics required by the fourteen junior colleges was 18.5 units. This is an average of 1.3 units for the fourteen that required prerequisites in mathematics and an average of .7 units for the twenty-five junior colleges that answered the question on prerequisites.

Entrance Examinations in Mathematics and Refresher Courses in Mathematics — Seventeen of the twenty-seven junior colleges indicated that they offered a course in refresher mathematics while the other ten indicated that they did not. Only six of the refresher courses could be accounted for in the content courses which were recorded by the respondents. Five were courses that carried credit and are listed in

TABLE XXII

High School Mathematics Prerequisites Required by the Junior Colleges

Units	Courses	Frequency White	Negro	Total
0		11	0	11
1	Any Mathematics	1	0	1
	Algebra	3	0	3
2	One Algebra and One Geometry	2	1	3
	One Algebra and One Any Mathematics	2	0	2
	Two Any Mathematics	2	0	2
	Two Algebra	1	0	1
2.5	One and one-half Algebra; One Geometry	1	0	1
3	One Algebra; One Geometry; One-half Trigonometry; One-half Basic Mathematics	0	1	1
	TOTAL	23	2	25

Table XXIII. The sixth course was a non-credit course and consisted of Scott Foresman's Workbook, Review of Mathematics. The balance of the refresher work in arithmetic could not be determined from the information available.

Twenty-seven of the junior colleges answered the question pertaining to mathematics entrance examinations. Sixteen indicated that they did give an examination in mathematics to all entering freshmen and eleven indicated that they did not. The nature of these examinations was not determined.

Hour Requirements in Content Mathematics — The total content mathematics required in the thirty junior college programs was 39.5

semester hours. This is an average of 1.3 semester hours per junior college. The distribution of these semester hours is shown in Table XXIII.

TABLE XXIII

Distribution of Hours of Content Mathematics in the Junior Colleges

	Semester Hours				
	2-2.9	3-3.9	5-5.9	6-6.9	None
White Junior Colleges	3	2	0	2	20
Negro Junior Colleges	0	1	1	1	0
Total	3	3	1	3	20

Table XXIII shows that twenty, or two-thirds, of the junior colleges did not require any content mathematics of their prospective elementary teachers. Four of the colleges required two semesters and six required one semester of content mathematics.

Hour Requirements in the Methods of Teaching Arithmetic — Fifteen of the thirty schools reported that they required a special course in the methods of teaching arithmetic, and two indicated that they included methods of teaching arithmetic in a general methods course. The seventeen schools that required work in the methods of teaching arithmetic required a total of 46.3 semester hours. This is an average of 2.7 semester hours for the colleges that required the course and an average of 1.5 semester hours for the thirty junior colleges that reported a program for the education of elementary teachers. The distribution of the semester hours of credit required in the methods of teaching arithmetic is listed in Table XXIV.

TABLE XXIV

Distribution of Hours in the Methods of Teaching Arithmetic in the Junior Colleges

	Semester Hours					
	0-.9	2-2.9	3-3.9	6-6.9	None	Total
White Junior Colleges	1	3	11	0	12	27
Negro Junior Colleges	1	0	0	1	1	3
Total	2	3	11	1	13	30

Total Hour Requirements in Content Mathematics and Methods of Teaching Arithmetic — The thirty junior colleges reported a total of 85.8 semester hours of content mathematics and methods of teaching arithmetic for the completion of their elementary education programs. This is an average of 2.9 semester hours per college. The distribution of the hours required in content mathematics and methods of teaching arithmetic for the separate programs is shown in Table XXV.

Table XXV reveals that six of the white institutions did not require any mathematics of their elementary education majors. The average requirement represents approximately one course in either mathematics content or methods of teaching arithmetic.

Content Mathematics Courses Required in Junior Colleges

Basal Textbooks Used in Content Mathematics Courses — Six basal textbooks and three workbooks were selected for the fourteen required content mathematics courses in the junior colleges. The names of the

TABLE XXV

Distribution of Total Hours Required in Mathematics in the Junior Colleges

	Semester Hours							
	0-.9	2-2.9	3-3.9	5-5.9	6-6.9	12-12.9	None	Total
White Junior Colleges	1	6	11	0	3	0	6	27
Negro Junior Colleges	0	0	1	1	0	1	0	3
Total	1	6	12	1	3	1	6	30

basal textbooks used in the courses give some indication of the classification of the material included in the courses. The basal textbooks are listed in Table XXVI.

TABLE XXVI

Basal Textbooks Used in Content Mathematics in the Junior Colleges

Author	Textbook	Frequency		
		White	Negro	Total
Rosenbach & Whitman	College Algebra	3	0	3
Wentworth	College Algebra	1	0	1
Betz	Basic Mathematics	1	1	2
Keller and Zant	Basic Mathematics	1	0	1
Kokomoor	Math. in Human Affairs	0	1	1
Newson	Introd. to College Math.	1	0	1
	Workbooks - Review of Arithmetic	2	1	3

Classification of Content Mathematics Courses — On a basis of the textbooks and materials listed as basal texts, the content mathematics required in the junior colleges was classified as four courses in college algebra, four courses in general college mathematics, four courses in review of arithmetic, and one course in introduction to college mathematics. All of the courses listed above were one semester courses except one course in algebra and one course in general college mathematics, which were two semester courses. The four colleges that required two semesters of content mathematics of their elementary education majors selected the following combinations: (1) two semesters of algebra, (2) two semesters of general college mathematics (3) one semester of algebra and one semester of review of arithmetic, and (4) one semester of algebra and one semester of general college mathematics.

Basal Textbooks Used in the Methods of Teaching Arithmetic Courses

The basal textbooks used in the methods of teaching arithmetic are listed in Table XXVII. Two of the junior colleges used two textbooks; therefore there are nineteen notations for the seventeen required courses.

One of the junior colleges using two basal textbooks combined Spitzer's The Teaching of Arithmetic and Taylor and Mills' Arithmetic for Teacher-Training Classes; the other college combined Brueckner and Grossnickle's How to Make Arithmetic Meaningful and Taylor and Mills' Arithmetic for Teacher Training Classes. Two of the junior colleges did not select a basal textbook for their special methods

TABLE XXVII

Basal Textbooks Used in the Methods of Teaching Arithmetic in the Junior Colleges

Author	Textbooks	Frequency		
		White	Negro	Total
Special Courses				
Taylor and Mills	Arithmetic for Teacher-Training Classes	6	0	6
Morton	Teaching Arithmetic in the Elementary Schools	3	0	3
Brueckner and Grossnickle	How to Make Arithmetic Meaningful	2	1	3
Rosentree & Taylor	An Arithmetic for Teachers	1	0	1
Spitzer	The Teaching of Arithmetic	1	0	1
Ginn and Co. Manual	and Workbook Grades I to VI	1	0	1
	No Basal Textbook	2	0	2
General Courses				
No Basal Textbook on the Teaching of Arithmetic		1	1	2

courses and the two junior colleges that included methods of teaching arithmetic in general courses did not use a basal textbook on the teaching of arithmetic. The most frequently used books were the textbooks by Taylor and Mills, Morton, and Brueckner and Grossnickle.

Instructors' Comments on Existing Programs

Twenty-eight of the respondents checked the question "Are you satisfied with the mathematical 'training' of the elementary teachers who have completed your program?" Two answered in the affirmative and twenty-six checked the negative response. A few of the comments which

were pertinent to this study are enclosed. The two numbers in parentheses preceding the comments designate the number of required semester hours of content mathematics and the number of required hours of methods of teaching arithmetic, respectively. The questionnaires were mailed to the mathematics departments; therefore, it is assumed that the comments made were from members of the mathematics departments.

The first two comments are from those that expressed satisfaction with their programs.

> (0,0) Ours is a small college limited to members and prospective members of our religious community of teach-Sisters — the Sisters of —. With the individual attention that our faculty — themselves excellently trained and long experienced teachers — can give to our students, each student receives exactly the help and training she needs.

> (0,0) We are satisfied with our program with the understanding that their training is not complete. We do not offer special courses for mathematics teachers. The demand is not sufficient at our school. It seems to me that such specialization can come in the junior and senior years of college work.

The following comments are typical examples of the remarks that accompanied the negative responses:

> (6, 6) I would have no teacher training courses in our junior college.

> (0, 0) I would require all teachers, especially elementary teachers, to take more mathematics; as I feel that elementary teachers in general are weak in that subject. The children whom they teach do not receive a good foundation in the subject.

> (3, 0) I would require Teaching Arithmetic, Plane Geometry, Algebra, and Trigonometry.

> (0, 3) I would require refresher course and then methods of teaching arithmetic rather than the combination.

(0, 3) I would require a three hour course in arithmetic content in addition to the three hour course in methods of teaching.

(0, 3) Introduction of more cultural subjects to replace methods courses. If the teacher has a rich background, it seems to me that the presentation would need less technical preparation. Modern educational methods stress altogether too much ways and means, losing the full ripeness of matter.

(0, 0) I would offer a course in fifth, sixth, and seventh grade arithmetic — not a course in how to teach it but rather a content course. In education courses, theoretically, they learn how to teach what they know. My idea is that very few of these teachers really know sixth, seventh, and eighth grade arithmetic. How can they teach it?

(3, 0) Offer a course in the methods of teaching arithmetic and a course in elementary business arithmetic. I would also like to see the two-year program extended to four years.

Summary

1. The junior colleges in Florida, Georgia, Kentucky, Mississippi, South Carolina, and Tennessee are active in the education of elementary teachers. Twenty-six junior colleges in these states reported 1,291 teachers qualified for their elementary certificates between June 15, 1949 and June 15, 1950.

2. The total required mathematics, both content and methods, reported by thirty junior colleges for elementary education majors averaged 2.9 semester hours per college. The content mathematics averaged 1.3 semester hours; the methods of teaching arithmetic averaged 1.5 semester hours.

3. The junior colleges did not agree on the number of hours or

type of content mathematics that should be required of elementary education majors. The required content mathematics varied from two semesters of algebra to one semester of review of arithmetic.

4. Fifteen of the thirty junior colleges required a special course in the methods of teaching arithmetic and two others included methods of teaching arithmetic in a general methods course.

5. Fourteen out of twenty-five junior colleges reported that they required prerequisites in mathematics. The average mathematics prerequisites reported in these twenty-five junior colleges was .7 unit. Seventeen of the twenty-seven junior colleges indicated that they offered refresher courses in mathematics. Sixteen of the twenty-seven reported that they gave entering freshmen entrance examinations in mathematics.

6. Of the eighteen constructive comments and suggestions, twelve indicated that they would like to see more mathematics required of prospective elementary teachers. They did not agree on the mathematics that should be added. The suggestions varied from sixth, seventh, and eighth grade arithmetic to business mathematics and trigonometry. Two indicated that they thought that teachers should not be educated in two-year institutions and two indicated that they needed more time for their work.

CHAPTER VII

GENERAL SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study has been to analyze the programs for the mathematical preparation of elementary teachers in a selected group of teacher education institutions in the Southeastern states and to make recommendations for the improvement of these programs. A summary of the analysis of the programs provided in the four-year institutions was presented at the end of Chapter V. A similar summary of the analysis of the programs provided in the junior colleges was presented at the end of Chapter VI. It is the purpose of this chapter to present a general summary and conclusions and to state the implications of the findings relating to the mathematical education of elementary teachers.

General Summary and Conclusions

A summary of the literature in the field of mathematics education of elementary teachers indicated that:

1. Pupils who have completed the elementary programs have been criticized for their lack of ability to cope with the fundamental arithmetic concepts and skills demanded by their studies and work.

2. The need for better prepared arithmetic teachers has existed since the establishment of the first schools. Prospective teachers and teachers in-service do not have a mastery of certain basic mathematical understandings. Research studies show that elementary teachers — in-service as well as prospective — understand only

about one-half of the principles considered to be basic to the computational processes commonly taught in grades one through six.

3. The grade placement and content of the arithmetic taught in the elementary schools has been fairly uniform for the past few years. However, arithmetic teachers and those interested in the education of arithmetic teachers are not in agreement on philosophy, aims, modes of learning, and practices in the teaching of arithmetic.

4. Recommendations from agencies assigned to study the problem of mathematical education of elementary teachers and recommendations from the few recent research studies concerned with the problem are in close agreement on the minimum mathematical education desired for prospective elementary teachers. The majority of these reports recommend:

a. A bachelor's degree
b. A basic course in arithmetic
c. A basic course in general mathematics
d. A special course in the methods of teaching arithmetic

A summary of the certification requirements of the nine selected states reveals:

1. Six states grant a regular — non-provisional — certificate on a basis of two years of college work, one state required three years as a minimum, and two states at least a bachelor's degree. Two of the nine states grant emergency certificates without college work. The tendency is to require at least a bachelor's degree for the highest certificates — one state requires two years of college work, four a bachelor's degree, two a master's degree, and two an earned doctor's

degree or its equivalent.

2. State certification requirements for elementary teachers tend to avoid the inclusion of courses in content mathematics and the methods of teaching arithmetic. Tennessee is the only state out of the nine that specifically designated that elementary education majors should complete a course in content mathematics in order to be certified to teach in the elementary schools, while Kentucky is the only state included in the study that specified a course in the methods of teaching arithmetic for elementary education majors. Florida and Mississippi offer content mathematics as a choice in a field of work, part of which is required. All of the states, except North Carolina, South Carolina, and Virginia, required work in general methods and/or materials.

3. None of the states included in this study required any more content mathematics or methods of teaching arithmetic for the highest regular certificate than they did for the lowest regular certificate.

The data for the white and negro programs for the education of prospective elementary arithmetic teachers were presented separately. A comparison of these data indicates:

A. The negro institutions included in this study required more hours of content mathematics than did the white institutions — 4.3 semester hours per institution as compared with 1.8 semester hours.

B. The negro institutions put more emphasis on a review of the grade arithmetic than did white institutions — 29.2 per cent of the total content mathematics required as compared with 5.8 per cent.

C. In the courses classified as Arithmetic for Teachers, the white institutions emphasized algebraic, geometric, and trigonometric concepts more than did the negro institutions — 24.6 per cent of the total items as compared with 10.0 per cent.

D. The white instructors of the special methods courses in the teaching of arithmetic had more college education than did the negro instructors. Ten white instructors held doctor's degrees and five white and six negro instructors held master's degrees.

E. There was very little difference between the white and negro institutions with regard to:

a. The per cent of total semester hours of content mathematics assigned to Arithmetic for Teachers

b. The content of their general college mathematics courses

c. The content of the methods of teaching arithmetic courses

d. The units of high school mathematics prerequisites required for admission to the general colleges.

The data on the junior colleges that prepare elementary teachers were not nearly as complete as the data on the four-year institutions; however, a comparison of the available data reveals:

1. The average number of elementary graduates reported by the junior colleges was higher than the average number of graduates from the four-year institutions in the same states — fifty per junior college as compared with twenty-nine per four-year institution.

2. The four-year institutions required more content mathematics than did the junior colleges — 1.8 semester hours as compared with 1.3

semester hours.

3. The four-year institutions put more emphasis on Arithmetic for Teachers than did the junior colleges — 39 per cent of the total content mathematics as compared with zero per cent for the junior colleges. The four-year institutions, even though they had smaller numbers, had more content mathematics courses designed especially for elementary teachers.

4. The junior colleges put more emphasis on review of grade arithmetic than did the four-year institutions — 25 per cent of the total content mathematics as compared with 6 per cent.

5. There was very little difference between the four-year institutions and the junior colleges with regard to:

a. The average number of hours required in the methods of teaching arithmetic.

b. The units of high school mathematics prerequisites required for admission.

The following summarizations are made on a basis of the related research and the data from this study.

Few comparisons can be drawn from the related research and the data from this study, because the related research attempted to analyze the mathematics offerings and requirements of teacher education institutions that included teachers' colleges and normal schools that were scattered over the entire United States. The related research studies are from fifteen to twenty years old. The majority of the related studies were based on an analysis of the courses listed in the catalogs

that were issued by the colleges and normal schools. The following conclusions are listed by the writer with the understanding that the classifications and locale of the institutions in some instances are not comparable in every sense.

1. The textbooks used in the methods of teaching arithmetic in the past eighteen years have been produced by a relatively small group of writers. In 1932 Judd and Morton reported on the adopted textbooks used in the teacher education institutions by the instructors that taught "teacher-training" courses in arithmetic. Listed in order of frequency, the texts were by Morton, Roantree and Taylor, and Stone-Mallory and Grossnickle. The most frequently adopted texts, listed in order of frequency, used in the methods courses included in this study were written by Morton, Brueckner and Grossnickle, Taylor and Mills, and Spitzer.

2. A greater per cent of the institutions included in this study specified mathematics as a prerequisite to admission than of the institutions included by Judd and Morton in 1932. Of 101 institutions in 1932, which were located through the United States and were members of the American Association of Teachers Colleges, 30 per cent required mathematics as a prerequisite; in this 1950 study, of the fifty institutions located in the Southeastern states 42 per cent required mathematics as a prerequisite.

3. A slightly higher per cent of the four-year institutions included in this study required content mathematics of their elementary education majors than was reported by the 1933 Commission of the United

States Office of Education. The 1933 report was based on an analysis of sixty-six teachers colleges and normal schools — 66 per cent in this study required content mathematics as compared with 52 per cent in the 1933 report.

4. There seems to be a trend for teacher education institutions to increase the amount of mathematics in their programs designed for elementary education majors. In 1928 Taylor reported on an analysis of the published curriculums of 187 normal schools and teachers colleges in forty-two states. According to Taylor's report, 25 per cent of the curriculums for the education of teachers did not include any content mathematics or methods of teaching arithmetic. /Results did not indicate whether or not methods of teaching arithmetic from general methods courses were included./ All of the four-year institutions and 80 per cent of the junior colleges included in this study reported some mathematics either content and/or methods in their curriculums for elementary teachers.

5. The mathematical requirements both content and methods courses of the institutions included in this study are far below the minimum recommended by the agencies and research studies concerned with the problem of the education of elementary teachers.

A comparison of the certification requirements and the data from this study reveal:

1. Institutions — four-year as well as junior colleges — have requirements in arithmetic experiences for prospective elementary teachers that exceed those of certification departments of the respec-

tive states. For example, there is little difference in total mathematics experiences required of students in institutions from the six states that have certification requirements of mathematics content and/or methods and the three states that have no such specific requirements. It would appear that the number of hours that was specified by the respective states was so low that it had little or no effect on the number of hours required by the institutions.

2. The state certification regulations that specified mathematics content and/or methods listed their requirements by giving names of courses. This study showed that the institutions did not agree on the concepts, skills, and methods that should be included in these courses to meet the state requirements.

Recommendations

The position was taken in this study that the first step in organizing an effective program for the mathematical education of elementary teachers was to analyze the existing programs. The literature, opinions of respondents, and the data from this study strongly support the following recommendations with respect to programs for the mathematical education of elementary majors.

Many of the students leaving the elementary schools are unable to meet satisfactorily the mathematical situations which confront them in their studies and work. They are especially weak in mathematics understanding and problem solving. A large number of these students have not corrected their mathematics deficiencies when they enter teacher

education institutions aspiring to be elementary teachers. Research studies show that teachers that have completed the elementary education programs designed for elementary majors understand about one-half of the mathematical concepts and skills which they will be required to teach in the elementary schools. These elementary teachers cannot hope to lead their students to a level of mathematical understanding higher than they themselves have attained. This fact of poorly prepared students becoming poorly prepared teachers and going out to continue to produce more poorly prepared students is a vicious cycle that must be broken if the products of the elementary schools are to show any marked improvement in mathematical concepts and skills — especially understanding and problem solving.

Recommendations for Selection of Elementary Education Majors — Since the need for qualified elementary teahhers is extremely critical, it is suggested that the teacher education institutions continue at the present time to admit students as elementary education majors regardless of their competency in mathematics. However, if the institutions admit students conditionally with exceptionally low level of competence in arithmetic, then the institutions must assume the responsibility of providing the willing and capable students with the opportunity to correct their deficiencies.

The Commission on Post-War Plans listed the basic mathematical concepts and skills which should be taught in the elementary school and in the junior high school. Until a better instrument is validated it is suggested by the writer that the items in these lists be used

as a basis for the selection or construction of a diagnostic examination.

Recommendations for Mathematics Programs for Elementary Education Majors — It is assumed by the writer that every elementary teacher should have, among other things, a mastery of the fundamental concepts and skills taught in elementary arithmetic and junior high school mathematics, as well as a clear concept of aims and objectives of arithmetic instruction, a desirable philosophy of arithmetic, an understanding of the best methods of learning, and effective techniques of teaching. Furthermore, it is the responsibility of the teacher education institution to see that the prospective elementary teacher is given an opportunity to develop these assets.

It was revealed in this study that the number of elementary majors in the majority of the institutions, junior colleges as well as four-year institutions, was large enough to warrant courses designed for elementary teachers. With one exception, each of the institutions had available a large number of content mathematics courses. In most cases the mathematics courses that were required of elementary majors were planned by the faculties of the mathematics departments without consultation with the advisors of the elementary education majors. Since these mathematics courses were already available, many of the institutions, especially the junior colleges, required prospective elementary teachers to take one or more of them rather than plan a course primarily for these teachers. Such a procedure is contrary to the recommendations that were made by the committees interested in the problem.

It will take intelligent and extensive study to formulate the total mathematical experiences that should be provided for elementary teachers. This study should be conducted by a co-operating group of interested educators from all levels of instruction. Until this study has been completed, it is recommended that the mathematics and education faculties jointly plan a content mathematics course. Such planning may extend over several years and may involve constant experimentation and evaluation of ideas. Students entering the elementary program will differ considerably on their mastery of arithmetic. Recognition of this fact must be made by the faculties in the planning of the arithmetic course. Those students with very low level of competence in arithmetic should be given special attention within the arithmetic course or should be given special instruction separately before taking the regular arithmetic course. If the latter procedure is followed, those students who show inability to raise their level of competence in arithmetic may be advised to withdraw from the elementary program.

It is further recommended that the equivalent of approximately three semester hours of time be devoted to a consideration of the methods of teaching arithmetic. It is desirable that this course be taught by an instructor who has had extensive education in mathematics and education. The purpose of this course should be to provide the prospective teacher with a unified set of aims, a desirable mathematical philosophy, a knowledge of the best modes of learning, and effective techniques of teaching. This study has shown that there is

disagreement as to the relative importance of topics and experiences to be provided for the students in the methods of teaching arithmetic. It will take exhaustive research and experimentation to draft the contents of a desirable methods course.

Recommendations for In-Service Education of Elementary Arithmetic Teachers — It should be the responsibility of every institution to keep a detailed record of the evaluation of every graduate. The number of entries per year should probably be inversely proportional to the teacher's length of service. The evaluation of the teacher's work should be made by the teacher's immediate superior and visiting staff member. The teacher's self-evaluation and the teacher's suggestions for the improvement of the institution's program should be enclosed in the record. Wider institution-school relationship should be encouraged. The in-service teachers should be encouraged and provided with the opportunity to take any of the recommended courses.

Suggested Problems for Research

This study has been concerned primarily with the programs for the mathematical education of prospective elementary teachers in the Southeastern states. The emphasis has been toward an analysis of the content mathematics and the methods of teaching arithmetic offered and required by the teacher education institutions. The comments of the staff members were the only criteria employed in an attempt to evaluate the individual programs. The great differences that exist in the amount and the content of the mathematics courses required of prospective

elementary teachers would indicate that research is needed on such specific items as: What items should be included in a content mathematics course designated for elementary teachers? What types of experiences should be included in the course designated as methods of teaching arithmetic? What techniques are most effective in presenting fundamental arithmetical concepts and skills? What are the most effective ways to evaluate the work of in-service teachers?

APPENDIX A

Questionnaire I and Accompanying Letter

2342 N. W. Seventh Court
Gainesville, Florida
April 27, 1950

I am planning a study of the mathematical training given to prospective elementary school teachers. My plan is to interview the person in charge of the elementary education program in a sample of the institutions in the Southeast. I would appreciate receiving the information asked for on the enclosed card as a prelude to the study.

This study has the approval of my advisory committee for D Ed program at University of Florida.

Sincerely yours,

Ralph W. Young

---

1. Do you offer a program for the training of elementary teachers that can be completed in 1____, 2____, 3____, 4____, 5____ years of total college work? Please check all that apply.
2. Approximately how many students will have completed each of the programs between June 15, 1949 and June 15, 1950? 1____, 2____, 3____, 4____, 5____ years.
3. Name and title of person in charge of Elementary Education.

_____

_____

APPENDIX B

Date Sheet Used in Interviews

I. General Information: Date _____

1. Institution: _____

2. Location: _____

3. Enrollment: _____

4. Number of students completing a 2 year program: _____

5. Number of students completing a 4 year program: _____

6. Individuals Interviewed:

_____ _____ Dept.

_____ _____ Dept.

_____ _____ Dept.

II. Types of programs offered. Listed in terms of total time required for completion:

_____years. (Hrs. given in sem. ____ or quarters ____)

Mathematical requirements. (Content - Methods)

_____

_____

_____

_____

_____years.

_____

_____

_____

_____

III. Organization:

1. Mathematical education is under supervision of:
   a. Education Dept. _____
   b. Mathematics Dept. _____
   c. Ed. and Math. Dept. _____

2. Pre-Service preparation:
   _____ years of general education followed by professional education.
   ( ) Integrated course work.

3. Who formulates the mathematical requirements for the different programs?

   _____

4. Does each student have a faculty advisor to aid him in the selection of his courses? ( ) yes ( ) no.

IV. Selectivity of Students:

1. What high school mathematics is required for admission to the elementary program?

   _____

   _____

2. Are freshmen given a mathematical examination or test when enrolled? ( ) yes ( ) no.

   a. Description of the test: _____

   _____

   b. Uses made of the test: _____

   _____

   c. Do you have available results from state wide tests which were given to High School seniors:

   _____

3. Is a refresher course in mathematics required if a student has a deficiency in mathematics? ( ) yes ( ) no.

4. Description of the refresher course in mathematics:

   a. Text: _____
   b. Hours of credit: _____
   c. Content:

V. Detailed outline of the work offered in methods of teaching arithmetic:

1. Is there a separate course for Methods in Teaching of Arithmetic? ( ) yes ( ) no.

2. If there is not a separate course, what subjects are combined:

_____ _____ _____

3. Time allocated to arithmetic: _____

4. Credit hours for the course: _____

5. Is the course required of all elementary teachers? ( ) yes ( ) no.

6. Instructor: _____

Training: _____

Experience in college: _____

Experience in elementary schools: _____

_____

7. Text used: _____

8. Supplementary texts: _____
(check list)

9. Syllabus of course or check list of topics.

10. Comments of instructor on course:

Supplementary Texts:

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2. Brownell, Arithmetic in Grades I and II, Duke Press, 1941.
3. Brueckner, Diagnostic and Remedial Teaching of Arithmetic, John Winston, 1930.
4. Brueckner, Arithmetic Knowledge and Abilities of Children in Grades I and II, Educational Publishers, 1948.
5. Brueckner and Grossnickle, How to Make Arithmetic Meaningful, Winston Co., 1947.
6. Buckingham, Elementary Arithmetic; Its Meaning and Practice, Ginn and Company, 1947.
7. Drummond, The Psychology and Teaching of Number, World Book Co., 1922.
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9. Klapper, The Teaching of Arithmetic, Appleton Cent., 1934.
10. Lamborn, Reason in Arithmetic, Oxford Press, 1930.
11. Morton, Teaching of Arithmetic in the Elementary School. Silver Burdett, 1937.
12. Rosenquist, Young Children Learn to Use Arithmetic, Ginn and Co., 1949.
13. Sanford, A Short History of Mathematics, Houghton Mifflin Co., 1930.
14. Smith, History of Mathematics, Ginn and Co., 1925.
15. Smith, Numbers and Numerals, Teachers College, 1937.
16. Spitzer, The Teaching of Arithmetic, Houghton Mifflin Company, 1948.
17. Stern, Children Discover Arithmetic: Harper and Bros., 1949.
18. Taylor and Mills, Arithmetic for Teacher Training Classes, Henry Holt and Company, 1949.
19. Wheat, Psychology and Teaching of Arithmetic, Heath, 1937.
20. Wilson, Stone, and Dalrymple, Teaching the New Arithmetic, McGraw Hill, 1939.
21. "Arithmetic in General Education," Sixteenth Year Book of National Council of Teachers of Mathematics.
22. "The Teaching of Arithmetic," Tenth Year Book of National Council of Teachers of Mathematics.
23. "Educational Diagnosis," Thirty-fourth Year Book of the National Society for the Study of Education.

General Methods:

24. Caltry and Dewey, A Guide in Observation and Student Teaching.
25. Lee and Lee, The Child and His Curriculum.
26. Macomber, Guiding Child Development in the Elementary School.
27. Ritter, Methods of Teaching in Town and Rural Schools.

VIII. Summary:

1. Is any follow up work done to determine the success of the teacher?

   _____

2. Do you have any special classes or work for the teachers in the field, such as Planning Committees, Policies Councils, Study Groups, Field Consultant Work, Workshops, etc.

3. Do you give any standardized tests to students at the end of the program? ( ) yes ( ) no.

   Test: _____

   Do you have any of the results available? _____

   _____

4. Are you satisfied with the mathematical education elementary teachers have received upon completion of your program? ( ) yes ( ) no.

   Evaluation and comments:

Data from Mathematics Department

VI. Content of Mathematics Courses Suitable for Elementary Teachers.

List of Courses	Hrs.	Text-Author

VII. Detailed syllabi of all courses that are not listed under conventional titles:

___ I. Introduction
___ 1. Reasoning
___ 2. Intuition
___ 3. Deductive Reasoning
___ 4. Inductive Reasoning
___ 5. The Number System

___ II. Fundamental operations with whole numbers
___ 6. Addition
___ 7. Check addition
___ 8. Subtraction
___ 9. Check subtraction
___ 10. Multiplication
___ 11. Short cuts in multiplication
___ 12. Check by casting out nines
___ 13. Division
___ 14. Check division
___ 15. Order of operations
___ 16. Operation with zero
___ 17. Number bases
___ 18. Construction of number system with any base
___ 19. Four fundamental operations

___ III. Fractions
___ 20. Definition
___ 21. Proper and improper
___ 22. Basic laws in working with fractions
___ 23. Addition of fractions
___ 24. Multiplication of fractions
___ 25. Subtraction of fractions
___ 26. Division of fractions
___ 27. Reciprocals

___ IV. Decimals
___ 28. Meaning
___ 29. Rules for performing the Fundamental operations
___ 30. Approximate numbers
___ 31. Significant figures
___ 32. Rounding numbers
___ 33. Accuracy and precision
___ 34. Computation with approximate numbers

___ V. Denominate Numbers
___ 35. Relationship
___ 36. Fundamental operations
___ 37. Indirect measurement with geometric figures
___ 38. Board Measure
___ 39. Gas and electric meters
___ 40. Latitude and longitude
___ 41. Time belts
___ 42. Square and square root
___ 43. Tables of square and square root
___ 44. Square root by division
___ 45. Pythagorean Theory

___ VI. Percentages
___ 46. Definition
___ 47. Percents to decimals
___ 48. Percents to fractions
___ 49. Decimals to percents
___ 50. Fractions to percents
___ 51. Cases
___ 52. Commission
___ 53. Profit and loss
___ 54. Trade discount
___ 55. Budgeting
___ 56. Taxes

___ VII. Interest and discount
___ 57. Interest
___ 58. Bank discount
___ 59. Notes
___ 60. Tables for exact time
___ 61. Proceeds from non-interest notes
___ 62. Proceeds from interest bearing notes

___ VIII. Ratio and proportion
___ 63. Ratio
___ 64. Proportion
___ 65. Fundamental laws
___ 66. Direct and indirect proportions

___ IX. Elementary algebra
___ 67. Definition
___ 68. Addition
___ 69. Subtraction
___ 70. Multiplication
___ 71. Division
___ 72. Symbols of aggregation
___ 73. Factoring

___ 74. Add. and Subt. fractions
___ 75. Mult. and div.
___ 76. Fractional exponents
___ 77. Zero exponent
___ 78. Negative exponents
___ 79. Scientific notation

___ X. Graphs and Statistical Notation
___ 80. Definition
___ 81. Bar
___ 82. Line
___ 83. Line
___ 84. Circle
___ 85. Treatment of statistical data
___ 86. Measure of central tendency
___ 87. Frequency polygon
___ 88. Quartiles
___ 89. Standard deviation
___ 90. Grouped data
___ 91. Formulas for statistical measures
___ 92. Applications
___ 93. Correlation
___ 94. Pearson product-moment
___ 95. Using an assumed mean
___ 96. Spearman Rank Method
___ 97. Interpretation of correlation

___ XI. Equation
___ 98. Definition
___ 99. Solution of linear equations
___ 100. Systems of linear equations
___ 101. Problems of linear equations
___ 102. Solution by add. and subt.
___ 103. Three linear equations with three unknowns
___ 104. Quadratic equations
___ 105. Solution by factoring
___ 106. Quadratic formula
___ 107. Graph of an equation
___ 108. Linear equations by graph
___ 109. Quadratic equations by graph

___ XII. Formula
___ 110. Definition
___ 111. Use
___ 112. Making formulas by logical rea.
___ 113. Making formulas from tables
___ 114. Some useful formulas
___ 115. Evaluating formulas
___ 116. Transforming formulas

___ XIV. Logs
___ 117. Definition
___ 118. Rules for characteristic
___ 119. Rule for mantissa
___ 120. Multiplication and divn.
___ 121. Powers and roots
___ 122. The slide rule

___ XV. Trigonometry
___ 123. Meaning
___ 124. Trigonometric functions
___ 125. Use of tables
___ 126. To find function of angle
___ 127. To find angle from functim
___ 128. Solution of right triangle
___ 129. Angle of elevation
___ 130. Oblique triangles
___ 131. Function of obtuse angle
___ 132. Oblique triangles
___ 133. Law of cosines
___ 134. Law of sines
___ 135. Use of sine law
___ 136. Ambiguous case

___ XVI. Insurance
___ 137. Definition and types
___ 138. Rates
___ 139. Premiums
___ 140. Kinds of policies
___ 141. Mutual and stock companies
___ 142. Dividends

___ XVII. Installment Buying
___ 143. Methods of selling
___ 144. Cost to buyer
___ 145. Dollar cost
___ 146. Rate of interest
___ 147. Approx rate of interest
___ 148. Formula for int. rate
___ 149. Auto financing
___ 150. Cost of using auto.

___ XVIII. Long term finance
___ 151. Definition
___ 152. Compound interest formula
___ 153. Definition annuity
___ 154. Amount of annuity
___ 155. Present value of annuity
___ 156. Annuities due
___ 157. Retirement annuities
___ 158. Sinking Fund
___ 159. Amortization
___ 160. Definition of Bonds

___XIX. Investments

___161. Definition
___162. Short term, long term
___163. Stocks
___164. Bonds
___165. Property

APPENDIX C

Questionnaire II and Accompanying Letter

UNIVERSITY OF FLORIDA
College of Education
Bureau of Educational Research
Gainesville

April 29, 1950

Dear Sir:

I am conducting a study of the mathematical education given to prospective elementary school teachers in the Southeast. It is important that I secure a report of the part played by the junior colleges in this work because of their valued contribution to the program. I would appreciate receiving the information asked for on the enclosed questionnaire. If you would care to receive a copy of the summary of this report on the junior colleges, sign your name and address on the bottom of the last page of the questionnaire.

This study has had the approval of my advisory committee for Ed. D. program at the University of Florida.

Sincerely yours,

Ralph W. Young

Questionnaire on Mathematical Education of Elementary Teachers

1. Does _____ offer a program for the training of elementary teachers? Yes____ no____

2. Approximately how many students will have completed this program between June 15, 1949 and June 15, 1950?

3. Do you operate on terms or semesters? terms ____ sem.____

4. What content mathematics courses do you offer to prospective elementary teachers? What courses are required? (The following list is not a suggested program but presented for your convenience in checking)

Content Courses	Hours	Check if offered	Check if required of Elem. teachers	Text-Author
Basic Mathematics				
Arithmetic for Teachers				
College Algebra				
Plane Geometry				
Trigonometry				
(others)				

5. Do you offer a course in the Methods of Teaching Arithmetic? yes ___ no ___. If the answer is yes: How many hours of credit are given for this course? _____ Is this course required of all prospective elementary teachers? yes ___ no ___ What text do you use for this course? _____

6. What high school prerequisite mathematics courses do you require for entrance to the elementary program? _____

_____

7. Do you give an entrance mathematics examination or test to freshmen? yes _____ no _____

8. Do you offer a refresher course in mathematics to those who are deficient in mathematics? yes ___ no ___

9. Are you satisfied with the mathematical training of the elementary teachers who have completed your program? yes _____ no _____

10. If you had sufficient time and resources, what changes would you make in your program for the training of elementary school teachers?

APPENDIX D

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BIOGRAPHICAL SKETCH

The writer was born in Allen County, Indiana, on November 5, 1908. He attended elementary and high school in Lafayette Township, Allen County, Indiana. Undergraduate studies were pursued in Ball State Teachers College, Muncie, Indiana, from which college the writer was awarded the degree of Bachelor of Arts in mathematics and physics in 1931. The writer received the Master of Science degree in education from Indiana University, Bloomington, Indiana, in 1934 and the Master of Arts degree in mathematics from Lehigh University, Bethlehem, Pennsylvania, in 1948.

Since graduating from college, the writer has served eight years as a public school teacher and seven years as a school principal in the Indiana schools. Experience includes three years as instructor of mathematics -- two years at Lehigh University, Bethlehem, Pennsylvania, and one year at the University of Florida, Gainesville, Florida. At the present time he is professor of mathematics at Henderson State Teachers College, Arkadelphia, Arkansas.

The writer is a member of National Council of Teachers of Mathematics, American Mathematical Society, The Mathematics Association of America, Kappa Delta Pi, Phi Delta Kappa, and Arkansas Education Association.

This dissertation was prepared under the direction of the Chairman of the candidate's Supervisory Committee and has been approved by all members of the Committee. It was submitted to the Graduate Council and was approved as partial fulfilment of the requirements for the degree of Doctor of Education.

June 11, 1951

T. M. Simpson
Dean

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